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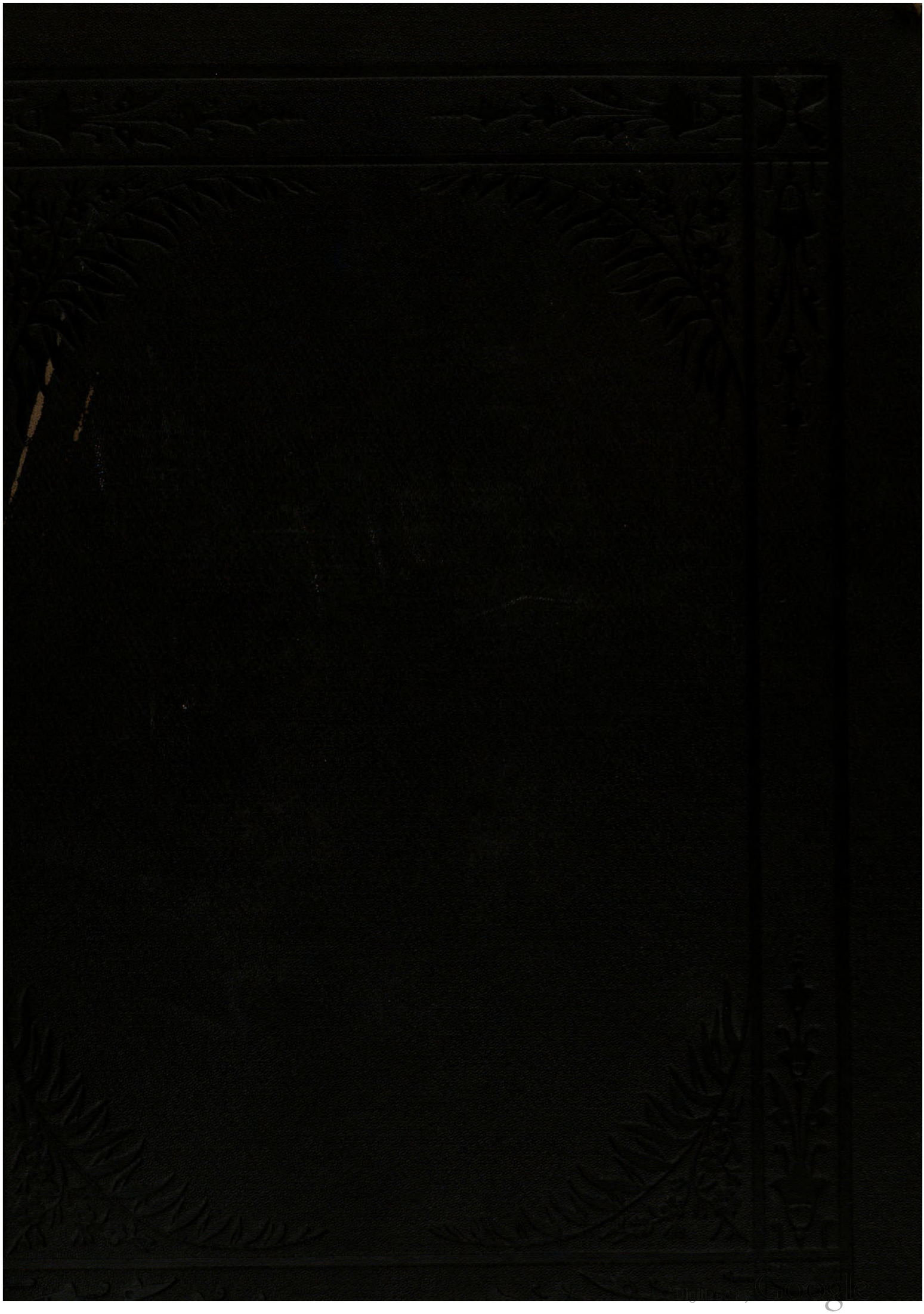
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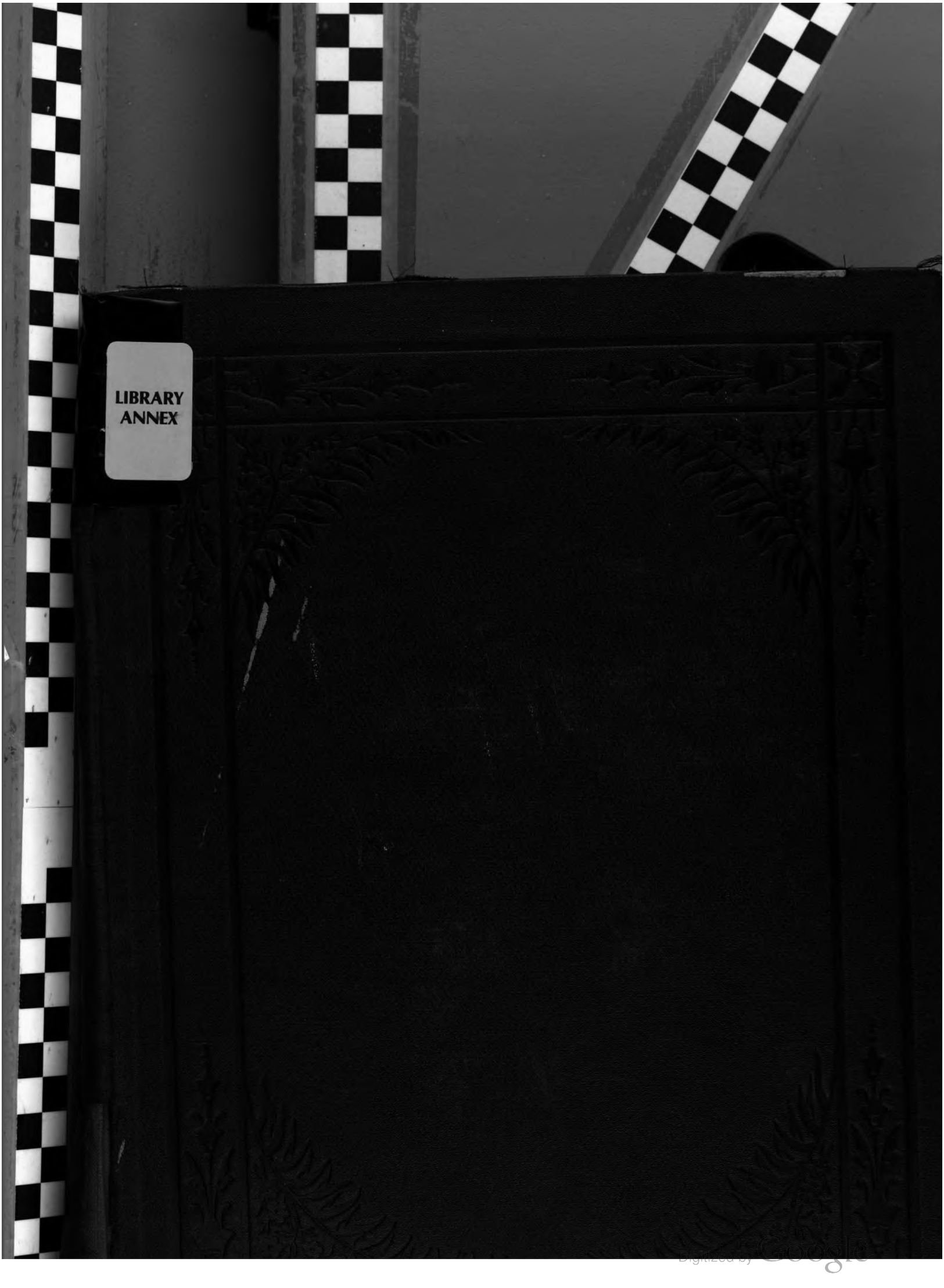

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THE ELECTRICIAN.

Vol. I. No. 1.] JANUARY, 1882. [50 Cents a Year. 5 Cents a Copy.

THE ELECTRICIAN.

THE JOURNAL herewith presented to the public has come into existence from the widespread and growing interest in the subject of ELECTRICITY in its present manifold application and employment.

We are hardly more than at the beginning of a development whose end, in the variety of its practical forms, it is impossible to foresee or conjecture. Its possibilities already declare themselves to be infinite. It is the mightiest spring on which man has yet laid his hand. The wonders it is destined to evoke are as unimaginable as they are unknown.

Now that Electricity has left the speculative field and entered the practical; or, rather, now that its full philosophical force has been turned, and is sure to be increasingly turned, to the use and benefit of mankind, we may look for it in every department of human interest and necessity.

The invention of the telegraph is already an old story, though within this generation. The men are not yet on the borders of old age who remember, in their young manhood, the tardy, reluctant, almost accidental, appropriation by Congress for the first wire between Washington and Baltimore; who were thrilled by the first prophetic message which passed over that earliest electric highway, from the fair fingers of Miss Annie Ellsworth. It is almost within a quarter of a century that the same electric highway was laid over the great submarine plateau between the old world and the new. And now the stupendous wonder of that hour—the practical annihilation of time and space—has become the commonplace of this. The novelty and excitement have passed away, but the improvements in telegraphy are so rapid and continual that the story is being constantly repeated in new and fresh forms, widening and opening on every hand in practical interest. It deserves a chronicle by itself.

The invention of the Telephone and the Microphone—the telescope and the microscope of the world of sound—though but of yesterday, have already left far behind the astonishment and romantic sensibility which greeted them. The one has entered and become a routine part of the everyday business necessity; the human voice making itself heard from afar at every commercial center and extending itself at will to any point on its circumference. The other, already the familiar friend of science, is reporting the hitherto unheard voices of nature to ears who are learning its various language. These, as yet, are only at their Baltimore-and-Washington stage. The whole miracle has not been wrought. The business world and the scientific world are alike awaiting that equally rapid series of improvements which will, in their turn, silence even the noise of the ocean when man would speak across it, and make the still earth give forth a roar as of a gigantic sea-shell when he would listen for it. And these improvements, at every stage of their occurrence, will demand their record.

The Electric Railway, a just accomplished fact on an experimental scale, between the Champs Elysees and the Exhibition building of some of the latest triumphs of electrical science and invention; the Electric Boat, still waiting for the one missing link, before it is fairly born of the laboratory and becomes a new denizen of the deep; the Electric Elevator, already in successful use and soon to become further known; the Electric Clock, by which all the time-pieces of a kingdom will strike the hours synchronously in their locality and with the precision of the sun: all these are promises yet destined to be fulfilled; infants which will have a voluminous history before long.

Last, but not least, the Electric Light, has come home, not only to the business, but the bosom, of the whole civilized world.

It is an interest, which, like the sunlight itself, permeates everywhere and is felt by everyone. For the time it is the nearest in practical importance to the public. The further it extends along the public streets and spreads into manufactories, shops, private dwellings, everywhere, the more will invention and contrivance have to follow it, and the more will the people desire to be kept abreast with its progress by a faithful, popular and scientific account of every step it makes on the way.

To this subject, for the moment of such universal and practical interest, THE ELECTRICIAN will, of course, give especial attention. It will seek to illustrate the superiority of the Electric Light over every other mode of illumination, not only in intensity, power, and volume, but in cheapness, safety, and applicability to every use, public and domestic, as well as in departments of activity which have hitherto been limited by the going down of the sun. If this wonderful illuminant has not only begun to mount guard upon the sea, in the light-house, and at the mast-head, but even to venture upon such delicate tracts of art as the canvas of the artist and the sensitive plate of the photographer, to what further invasions of the domain of darkness and to what further niceties of appropriation may it not be expected to descend!

Two years ago America was far behind Europe in solving the great problem of electric lighting, both in the variety and perfection of dynamo-electric machines and the number of lamps suggested. To-day her inven-

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tive genius places her at the front. She has found the most efficient and economical way of converting mechanical power into electric energy. The generator contrived on our soil evolves an electric current capable of subdivision, supplying a series of lamps in one circuit. A self-regulating lamp, durable, economical, and easily kept in order, adapted to this circuit, burns independently of all the others in the series, so far as its extinction or disturbance may affect them. To complete the requirement an automatic method has been devised to regulate the supply of electricity and to make the current exactly equal to the varying demands of the circuit.

This invention now leads the world, as is proved by its acceptance in England, France, Belgium, Austria, Russia, Italy, Spain, Norway, Sweden, Denmark, etc. Other inventions and improvements are treading close upon its heels, and the mind of the country is fairly awake.

An Indiana city enjoys the honor of having been the first in the world to light its streets wholly by electricity, and the city of New York, for awhile so tardy and behindhand, has now two huge central stations of power and distribution in process of construction under business management on a most gigantic scale. The lights are beginning to flash out everywhere, on the public squares, on the streets, in private houses, and wherever night traffic is carried on. We recently counted over one hundred and forty lamps on a single thoroughfare, within a space of a mile and a half.

These are, at present, the foremost manifestations of the subject of electricity in which the public are deeply and practically concerned; but, we may be certain that it will open in other directions, of equal moment, to be as widely recognized and appreciated.

It would seem to be high time that the country of Franklin, of Morse, Edison, Maxim, Bell, Brush, Weston, Hughes, Fuller, and of many another great name in Electrical Science, should be represented by a paper that would register the triumphs of genius and enterprise in this department.

It is with a view therefore of meeting what has now, in its turn, become a literary necessity, that the present Journal of Electricity is issued and asks the patronage of the American public.

It has been established under liberal, enlightened, and independent conditions, and will be devoted exclusiely to the field indicated by its name.

Its columns will be open, not only to the record of inventive activity in Electrical Science, but to discussions and contributions upon every branch of the subject.

Communications bearing upon both speculative and applied electricity are solicited from any competent quarter.

All this is but the commencement of a system which will soon be universal, and do its part in revolutionizing society, modifying our habits and customs, and opening new fields of activity, as much as the already increased facilities of conveyance, intercommunication, and water-supply—not to speak of its great twin-enterprise of this very moment in the metropolis, the distribution, also from a central station, of steam-heat in pipes, by which, as it will turn out, as *light* and its conveniences will be poured into our dwellings, offices, and factories, all *fire* and its dangers will be banished from them.

THE COLLINS SYSTEM FOR UNIFORM TIME.

THE *Compagnie des Chemins de Fer de l'Est* has introduced a method for having uniform time at all its stations.

Three methods may be used for regulating a series of clocks by electricity:

1. When a principal regulator advances a certain number of seconds it will cause an electric current to be emitted. This current will put on by a certain angle the handles of a series of clocks that are in the same circuit. As the motive power is furnished by the electric current, the clocks do not require any special mechanism.

2. A motor mechanism may be applied to each clock. The electric current will throw it out of gear.

3. Each clock has an independent motor mechanism, and the time can be given to all of them periodically, or, in other words, bring them into relation with the principal regulator.

This last system is the only one that is applicable to railroads, because it allows the telegraphic lines to be used without inconvenience. The other systems would necessitate special lines for each clock and the carriage of an electric motor.

In the Collins system all the clocks, including the regulator, have a commutator connected with their works. The commutator on the regulator closes the circuit connecting the clocks a few minutes before the regulating time (6 P.M., for instance). As soon as the regulator marks six o'clock, the commutator begins to work. All the clocks, it must be said, are to have a tendency to be fast.

The commutators in the other clocks close a derivated circuit in each at the precise moment that the regulator marks six o'clock. An electro-magnet is in the circuit, and this, under the influence of the current, acts on a lever that is furnished with a pin. The pin is inserted between the teeth of the escapement wheel, and stops it, while the pendulum continues to oscillate under the acquired impulsion. As all the clocks are fast, and as there can be only a few seconds difference in time when the regulating periods are not too long apart, it follows that a clock will mark six o'clock a few seconds in advance, but as communication with the pile will be made a few minutes before by the regulator, the electro-magnet will act at once and stop it.

When the regulator marks six o'clock, it will interrupt the current. The electro-magnets will consequently let go their armatures, and the clocks will begin to run again at six precisely.

Amherst College has introduced the Electric Light.

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THE LABORATORY OF "L'ELECTRICIEN."

CONSTRUCTION OF THE SECONDARY BATTERIES OF GASTEN PLANTÉ.

THE physical laboratory of which it is our purpose to give a description is situated in the "rue de Rueard," Paris, at the end of a courtyard.

This laboratory, founded by the managers of the journal *L'Electricien*, is especially designed for scientific and industrial researches.

During the past few months the construction of secondary batteries of Mr. G. Planté, have been studied, their importance becoming more and more apparent as the applications of electricity are augmented.

General attention having been directed to these batteries, it is thought that our readers will peruse with interest a few details of their construction.

The manufacture of secondary batteries comprises, 1st. Their construction, properly speaking. 2d. Their charging under the action of an electric current.

Our first figure represents the laboratory proper, where the batteries are made. They are begun and finished in series of sixty, each weighing about 10 kilogrammes.

They are constructed according to instructions given by Mr. G. Planté, in his Researches on Electricity, and according to the verbal instructions of this celebrated electrician.

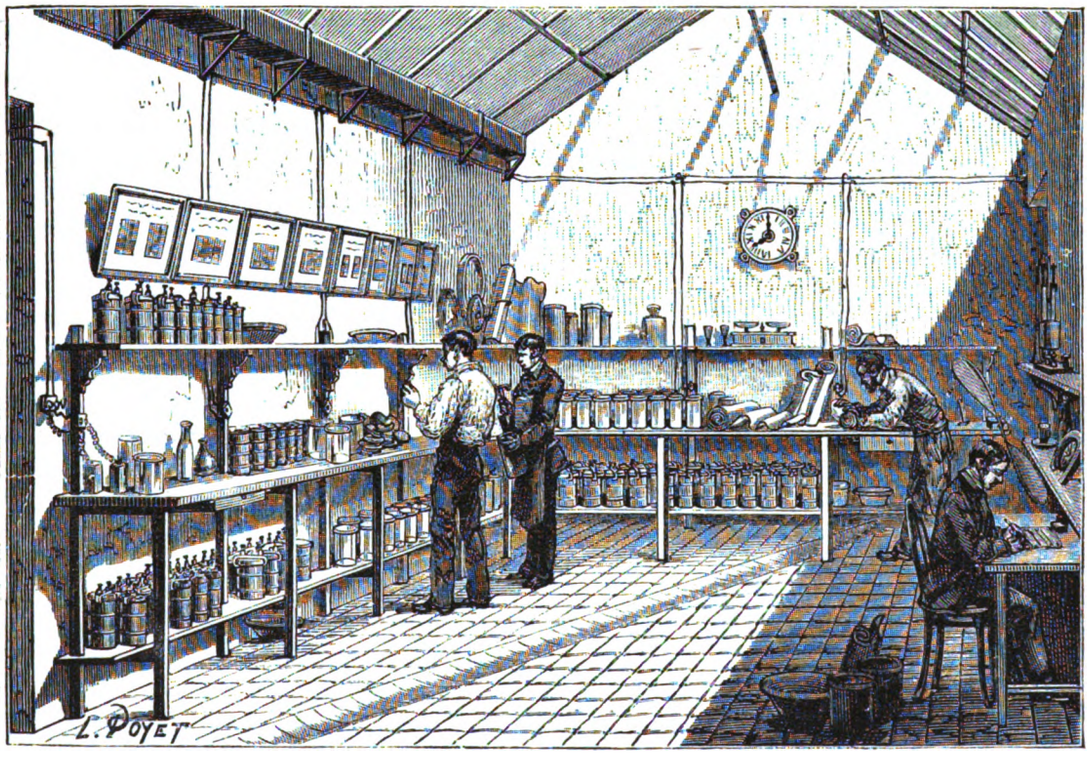
These batteries are composed of a cylindrical glass jar in which are enclosed two plates which are wound spirally upon each other, and separated by means of a thin sheet of caoutchouc. The element is then filled up with water acidulated with $\frac{1}{10}$ of pure sulphuric acid.

The battery thus formed is closed with a cork covered with matsic, and surmounted by a small yoke of wood permanently fastened, and into which are inserted two connections of copper which are attached to the positive and negative sheets of lead.

There are thus constructed in the laboratory of *L'Electricien* secondary couples of very light weight, of very thin sheets of lead and of large surface, apparently giving very surprising results, but of which we are unable to speak further until experiments of measurement have been made in an exact manner.

Accumulators of different systems are also studied here.

The secondary batteries being constructed are then charged by means of an electric current.



Laboratory of "L'Electricien."

Our second figure represents the arrangement adopted in the laboratory of *L'Electricien* to furnish a current of electricity under the necessary practical conditions.

The current is produced by means of two Gramme machines operated by an Otto gas engine of four horse-power. The first Gramme machine, that seen to the right, is one of the Class A, which is used in the charging and formation of the secondary batteries.

At the side of this machine is one giving alternating currents and which is used for different experiments. The first Gramme machine is operated through induced currents, but a smaller machine may be employed for this object, serving thus as an exciter.

The charging of the Planté secondary battery may be effected under the influence of currents furnished by the Gramme machine, but as the currents are very intense, it

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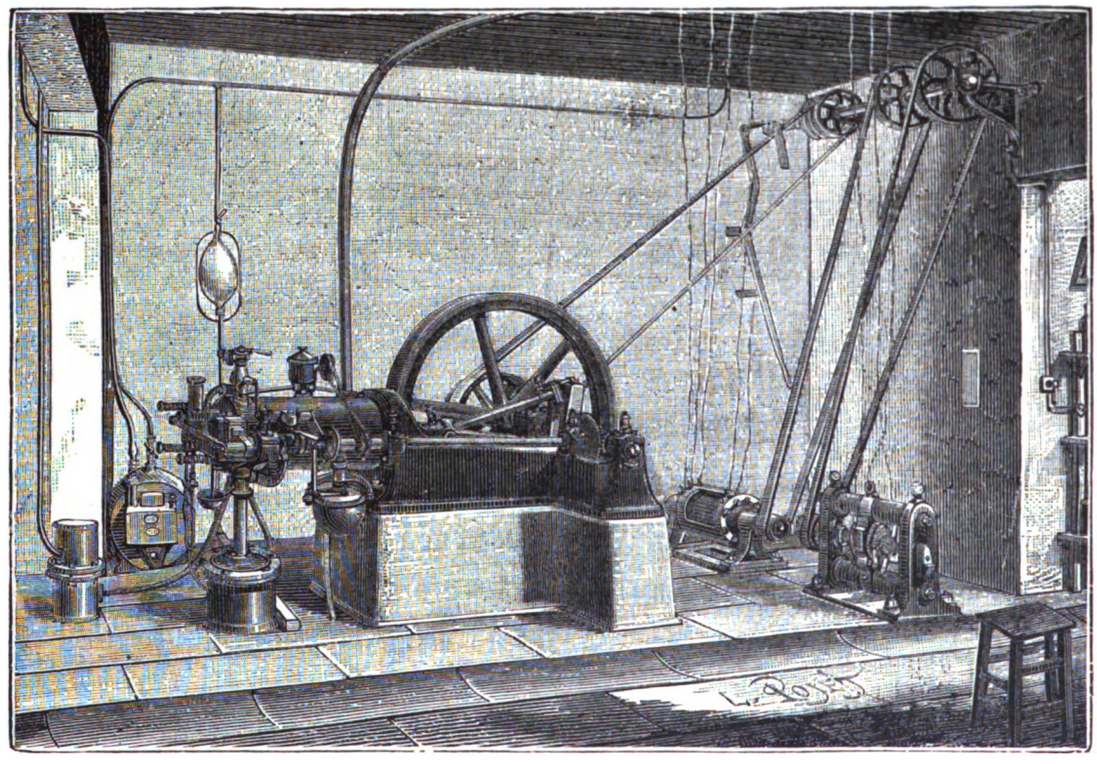
is necessary that a special arrangement should be made and that resistances should be interposed in the circuit.

There may thus be charged at a time a large number of elements. either arranged for quantity or intensity.

The arrangements which we have endeavored to succinctly describe may serve as the model for a workshop for the construction of the secondary batteries which are now soon to emerge from the domain of experimental science, to take a place in that of industry and practice.

The laboratory of *L'Electricien* comprises also three other parts which we have thonght unnecessary to represent by engravings. There are executed in them various experiments; notably the measurement of electro-motors and incandescent lamps.

The French and American engineers work here regularly, having at their disposal water, gas, electro-motive force,



Machinery Room of "L'Electricien."

that is to say all the elements necessary to ensure the success of their researches.

The laboratory of *L'Electricien* is an example too rare with us. A beautiful scientific undertaking founded by private enterprise ; we have thought it our duty to bring it to the attention of our readers, hoping that we may be able to present to them the work which may be therein executed.

STILL ANOTHER ENGLISH TOWN has adopted the telephone. At Canterbury, capital of County Kent and seat of the first archbishopric of the realm, telephonic communication is about to be established between the gas-works of Castle street and the Hydraulic Basins of Wincheap. The line will be eleven hundred yards long and will be laid in the earth, enclosed in tubes of iron.

*ELECTRIC LAMPS AT THE INTERNATIONAL EXPOSITION OF ELECTRICITY.**

AT present we intend simply to give a methodical classification of the different systems of electric lamps exhibited at the recent exposition in Paris, with a view to facilitate the study of them, without having any opinion on the respective merits of each. This classification seems to be the more needed, as in all those which have hitherto been made, there have been taken as the basis of classification characters, which, so far as the working of the several lamps is concerned, are of purely secondary importance. True, when these classifications were made, it was not possible to study so closely as we can to-day the inmost structure of each apparatus: but now, when inventions are multiplying, we are compelled to *dissect*, so to speak, each one, in order to discover wherein it differs from those which went before.

All apparatus whatever which transform electric energy into light are distributed into two classes, viz.:

1. The voltaic arc.
2. Incandescence.

This primary division, which has always been recognized, nevertheless is not rigorously exact, for between incandescence and the arc are certain systems which are to be referred to both.

THE VOLTAIC ARC.

Voltaic arc apparatus are of two kinds, viz.:

A. Carbons arranged in a *continuous line* with each other: these are *lamps*, or *regulators*.

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B. Carbons arranged *parallel* to each other: these are called *candles.*

We will examine them successively:—

A.—Regulators.

The term Regulator is applied to any system in which the carbons are kept at their normal distance from each other, by a mechanism more or less complex. We might distinguish between regulators that are fed by continuous currents and those fed by alternating currents; but this character is relatively of secondary importance, and it is best to base the subdivisions upon the light itself.

One very clear distinction is founded on the number of lights fed by a machine *on one circuit.*

On this basis we distinguish:

a. One-light, or *monophote* voltaic-arc regulators, *i. e.*, those which allow of *only one* lamp in the circuit.

b. Many-light, or *polyphote* regulators, or, as they are often called, *Division Regulators*, which allow of two, three, four, or an indefinite number of lights on one circuit. We remark, in passing, that all polyphote regulators can be made to work as monophote apparatus, by attaching only one lamp to a source of electricity having the appropriate power: but the converse does not hold good, for monophote regulators either work badly or do not work at all when many of them are placed in one circuit. The reason of this we will give in a few words:—

a. Monophote Regulators. In all monophote apparatus the current is regulated by *its intensity:* this is the peculiarity of this class of apparatus.

The current, as it comes from its source, traverses an electro-magnet and the voltaic arc. Should it grow weak, the electro-magnet weakens also, and allows the carbons to approach one another. Should it grow stronger, the electro-magnet increases the distance between the carbons. Every one can see that a system based on this principle cannot work when many lamps are placed in circuit. To make this clear, suppose we have just *two* lamps in circuit, regulated to an intensity of 25 webers. The normal distance between the carbons would be for example 3 millimeters; but after a while it will happen that one of the arcs will be not more than 2 millimeters in length, while the other will be 4 millimeters; but the intensity of the current will still be 25 webers. The lamps will have to depend on one another, instead of being mutually independent, and the light given by each will consequently be very unequal from one moment to another. We shall see presently how this difficulty is met. This sort of regulators are suitable especially for producing strong lights, such as are needed for light-houses, &c. They are also employed where electricity is developed by the pile, for theatres and for projections, and in many factories where only one light is needed, or where the plant is of the old style, and each light has its own generator of electricity. But for lighting shops and factories, where a number of lights are needed, the tendency now is to simplify the plant by introducing more powerful machines, and division regulators.

At the Exposition were to be seen a great number of *one-light* regulators. Of these some had springs to maintain the normal distance between the carbons, as we see in Foucault's and in Duboscq's apparatus; in others the positive carbon-holder served by its own weight to preserve the normal distance, as we see in Siemens, Maxim, Jasper, Crompton, Carre, Cance, Chertemps, Burgen and others.

The regulating is done by means of an electro-magnet, or of a solenoid; the currents that feed these regulators are either continuous or alternating, but the general and distinctive character of them all is, that the distance between the carbons is increased or lessened by the variations in *the intensity* of the current.

b. Polyphote or Division Regulators.—Every apparatus of this kind possesses some special contrivance to insure the independent working of each lamp. They may be subdivided into three distinct classes, viz.:

a. Differential Regulators;

b. Derivation Regulators;

c. Regulators *à écart fixe.*

We will briefly explain the principles that distinguish each of these, without regard to priority of invention, or chronological order.

a. Differential Regulators.—The regulating of the arc is here effected by the differential action of the main current that produces the voltaic arc, and of a highly resistant derivation established between the two carbons: thus, their distance apart depends both on the intensity of the current, and on the difference of potential at the base of the two carbons; and equilibrium is established for each lamp, when the intensity and the difference of potential have reached the point requisite for the good working of the lamp.

In Siemens's differential lamp there are two selenoids that work on one rod; in the Brush and the Weston lamps there is only one electro-magnet, but on this are coiled two wires that act in inverse directions. We may also mention as examples of differential regulators the Tchikoloff, the Schukert, the Crompton, the Gravier and the Berjot lamps.

b. Derivation Regulators.—In these apparatus, which must not be confounded with the differential regulators, we find the regulating of the arc effected, not by the variations in the intensity of the main current, but only by the variations in the differences of potential in the lamp. There is only one regulating electro-magnet, with fine wire and *in derivation.* If some of the apparatus in this class, the Gramme regulator, for instance, have a second electro-magnet, in which the general current circulates, that second electro-magnet serves only to separate the carbons *at the moment of lighting*, but it has nothing whatever to do with the *regulating*.

These apparatus possess this advantage, that they work with currents varying widely in their intensity, and the reason is, because, by the very principle of their construction, the intensity plays no part in regulating.

On this point there exists much confusion of ideas which it behooves us to remove.

Among the most important of the derivation regulators are those of Gramme and of Crompton, which are fed by

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continuous currents, and those of Mersanne, Gérard, and Lontin, fed by attenuating currents.

c. REGULATION À ÉCART FIXE.—To this class may be referred Rapieff's lamps, which were not in operation at the Exposition, and Brockie's lamps, which lighted a portion of the English section. In the Brokie lamp the readjustment of the distance between the carbons is effected automatically every minute or every half-minute.

B.—CANDLES.

In all Electric Candles the carbons are placed parallel to one another, and as the waste of the two must be equal, they are fed by alternating currents.

We have to distinguish here: 1. Candles *with columbin*, of which only one type was to be seen at the Exposition—the *Jablochkoff Candle;* 2. Candles *without columbin*, represented by the Wilde, the Jamin, and the Debrun apparatus. These three apparatus last mentioned have an automatic contrivance for lighting and relighting. The peculiarity of the Jamin is its *cadre directeur*. All these candles are apparatus *à écart fixe*, that is to say, in them the distance between the carbons is not affected by the variations in the electrical circulation. The candles without columbin are to be referred to the voltaic-arc class; Jablochkoff's candles possess the characters both of the arc and of incandescence.

Before passing to the subject of lighting by incandescence, we must notice, as an intermediate system, the Clerc and Burean lamps, better known as the Solar Lamp (*lampe-soleil*), which is allied to the candle by the nearly parallel arrangement of its two carbons, and to the incandescence class by the nature of its light, produced, as it is, by a piece of chalk raised to a very high temperature, and made incandescent by the passage of the current across the voltaic arc established between the two carbons, and which grazes its surface. In the case of the candles, as in that of the *lampe-soleil*, a certain number of apparatus can be placed in one circuit; hence we might regard them as a fourth class of electric light apparatus *by division* (*polyphote regulators*).

INCANDESCENCE.

The incandescence systems are far less numerous than those which employ the voltaic arc, and hence their classification is less complex. They are divided into.

1. Incandescent lamps with combustion;
2. Lamps purely incandescent.

The former were represented in the Exposition by Reynier's, Werdermann's (Napoli's modification), Joel's, and Tommasi's apparatus. All of these consist of a carbon rod resting lightly on a lump of carbon or an irregularly-shaped piece of metal, thus producing *imperfect contact.*

Pure incandescence is represented in four systems: those of Edison, Maxim, Swan, and Lane-Fox. In all of these we have incandescence of carbon, and this carbon consists of a very fine thread placed *in vacuo* or in a highly rarified atmosphere of some inert gas.

The nature of the current is a matter of indifference with incandescent lamps; they work with either continuous or with alternating currents. Those lamps in which there is incandescence *with combustion* require a great *volume* of current, and rise in *tension*, while those with pure incandescence require small volume, and usually rise in *quantity.*

To pure incandescence we must also refer Jablochkoff's Kavlins, Trouvé's platinum wire polyscopes and Geissler's tubes; but properly speaking these are not electric-light apparatus at all, but only objects to be used for study or for experiment.

Such were the general characters of the electric light systems on exhibition in the Palais d'Industrie. Later, we shall have occasion to pass them in review, and to describe them in detail, pointing out the latest improvements that have been made in them.

If some names have been overlooked, we must avow that others have been purposely omitted. Thus, it has been impossible for us to classify Messrs. Pilleaux and Quesnot's *lampe à arc voltaique solide* (lamp with solid voltaic arc) as they call it, Dandigny's *railway tubular regulator* (*regulateur tuberlaire à railway*), and sundry other lamps more or less perennial, which are put forward by certain inventors. Our classification, such as it is, is sufficiently complete, and shows in what a multiplicity of ways electric energy is now transferred into light.

*DIFFERENT SYSTEMS OF CENTRAL OFFICES FOR TELEPHONIC SERVICE.**

THERE is a general impression that the system of telegraphic communication from a central office is a subsequent invention to the telephone service, but the contrary is the case. The system of printed slips was used in New York in 1870, and was at first specially for the use of lawyers. The first application of a special wire for calls was made in this service, and is still known as the *Law* system.

These systems were regular networks of private telegraphic communication, as are in the present day our city telephonic service.

The apparatus known as the *Gold and Stock Telegraphs* was introduced even earlier. The subscribers received simultaneously the changing quotations of gold and stocks from a central office. The subscribers were grouped in batches of four or six on each wire. The great difference between this *Gold and Stock*, and the telephonic service, consisted in the subscribers to the former receiving only a series of printed dispatches, without having any means whatever for answering. There is a system of this kind in Paris, under the name of *Télégraphe des Bourses et Marchés*, and one in London with another appellation, but neither of them have attained the development of the system in America.

The invention of the telephone has given new importance to the central office systems, for, although America

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has precedence in practically applying them, it may be said, on the other hand, that the principal European cities possess at present a well organized telephonic service.

There are different methods for placing two subscribers in communication and effecting the other requisites of such a telephonic service. The following are the principal systems:

THE SWISS COMMUTATOR.—A great many companies use commutators with vertical and horizontal bars, of the same kind as those termed *universal* commutator in England, and *Swiss* commutator in France, and which we shall call commutators with *double entrance*. The vertical bars are for replying to subscribers, while the horizontal are useful for various purposes; placing two subscribers in direct communication with each other, or with the central office, &c. Metallic pins or stoppers, which are inserted in holes at the junction of the vertical and horizontal bars, effect these connections.

The central office has, besides, a set of indicators (one for each subscriber), which apprise the employee of his services being required. The movements to be made are as follows: Subscriber No. 1 calls the central; the attendant places pin No. 1 in the hole at the meeting of the horizontal bar joined to the telephone, and replies to the subscriber; the latter wishes to communicate with subscriber No. 5; the central then puts pins 1 and 5 on a single horizontal line and thus places the subscribers in direct communication.

When the conversation is ended, subscriber No. 1 informs the central of the fact, and the two lines are put in the at rest position. There is a great difference in the methods adopted by the various companies, and they are also affected by the peculiar conditions of each service.

CALL-OFF SYSTEM BY DERIVATION.—In some instances, the line is put in communication with indicator No. 1, or No. 5, (the other end of which goes to the earth,) by means of a supplementary pin, so that the telephonic line 1 to 5 has a terrestrial derivation in the central office.

It is preferable, however, to have special indicators for the call-off, one for each of the direct communication bars. These indicators have a greater resistance than the others, and are given 150, or even 300, ohms.

A portion of the undulatory currents is derived to the earth during the telephonic conversation, but is less in proportion as the derivation resistance is greater. It has been found in practice that there is no appreciable difference in the telephonic reception, whether derivation be altogether stopped, or one of 300 ohms be applied.

WITHOUT DERIVATION.—Another combination consists in putting the call-off indicator in the circuit of telephonic correspondence, and having it no longer in derivation. This can be effected by leaving the two indicators, 1 and 5, in the circuit; but special call-off indicators are better. This latter combination is preferred in America for offices of 250 subscribers, and two attendants are sufficient.

In calling off, with or without derivation, the current of the entire pile is transmuted by subscriber No. 1, and this sets the call-off indicator to work, and notifies the central.

THE JACK-KNIFE SYSTEM.—There are other systems besides the Swiss commutator which accomplish the same purpose. That known in America as the Jack-Knife has a peculiar device, from which it derives its name. It is a square piece of brass fixed to an upright board by means of two bolts.

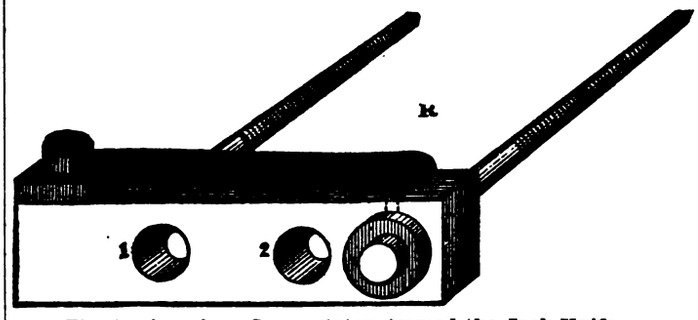

Fig. 1.—American Commutator, termed the Jack-Knife.

The first bolt 1 terminates in a screw, which seems to fasten the jack-knife, and at the same time to insure the contact between the subscriber's wire and the metallic mass. The second bolt 2 is put in communication in the same way with the indicator wire. This bolt is isolated, however, from the jack-knife, and is furnished with a small side metallic pin, standing erect, and isolated likewise from the mass; the end of the spring R rests on it. The jack-knife is then at rest; the line is in communication with the indicator—the other end of the latter being in the earth. If the subscriber sends a current, the indicator notifies the central. The jack-knife has two holes, 1 and 2; the employee then puts in hole No. 2, a pin, which is fastened to a metallic cord coming from the telephone. The pin raises a peg on the spring R, and, consequently, breaks the contact between the mass of the jack-knife and the indicator. The simple introduction of the pin does two things: it detaches the indicator from the line, and attaches it to the telephone. The employee then receives his instructions from the subscriber. To connect the two jack-knives, (Fig 2), a flexible metallic cord terminating in

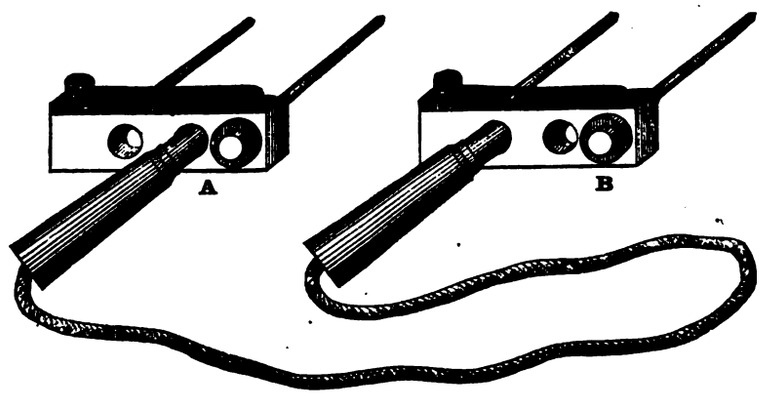

Fig. 2.—Communication Established with two Jack-Knifes.

two pins is used. These pins are inserted in holes 1 and 2. If one of the indicators is wanted to be in derivation,

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the corresponding pin is inserted in hole 1, the spring R, is not raised, and the mass of the jack-knife, which forms part of the line of correspondence, is connected with the indicator and the earth. The jack-knife admits of other combinations; special call-off indicators can be brought into the circuit of the communicating subscribers. This is done by two flexible cords, one going from the jack-knife A, to the entrance end of the indicator, and the other from the outlet end to the jack-knife B. This system, which requires the services of two employees only, where there are from 250 to 300 subscribers, is used in a great many American offices.

NUMBER OF CALLS.—It is easily understood how the number of calls that are received by a central office grows more rapidly than that of the subscribers. A simple calculation may be made on this subject:

Each of the n subscribers may want to speak with each of the $n-1$ other subscribers; this would give us $n(n-1)$ calls. But, it must be borne in mind, that the connection of No. 1 with No. 5 is not dissimilar to that of No. 5 with No. 1, and, consequently, the number $n(n-1)$ is double the real number of distinct communications, which is, therefore:

$$\frac{n(n-1)}{2}$$

If we have 501 subscribers to one office, the number will be:

$$\frac{501 \times 500}{2} = \frac{250{,}500}{2} = 125{,}250.$$

A proximate calculation may be made by taking the number of possible communications as equal to half the square of the number of subscribers. In practice, however, the effective number is much lower, as all the subscribers are not acquainted with each other, and none of them has business relations with all the others; but, still, it remains high, on account of the repetition of the same communication.

The working of offices with 500 and 1000 subscribers is very difficult, owing to the impatience of the subscribers. Several systems are used in America for meeting this difficulty, which are yet unknown in Europe.

THE LAW SYSTEM.—Here, each subscriber has his special wire from his office to the central. There is, besides, a call wire from the central to some 50 subscribers and returning to the central. The calls are made in different ways in the various cities. In Chicago each subscriber has a special telegraph, on the dials of which are various signals, as: "*I want to speak;*" "*Our conversation is finished.*" The turn of a handle will transmit a series of long and short currents on to a strip of paper in a receiver in the central, and a Morse dispatch will be given to an employee, who transmits it to another in charge of the commutator. The latter puts himself in telephonic communication with No. 57, by special wire No. 57, and at his request connects him with No. 45. The call-off, after the conversation is over, is effected in the same way as the call.

Another system is pursued in New York, where calls are made by telephone on a special wire. A young man has his ear to the telephone at the central. Subscriber No. 7 speaks and says, "*No. 7 wants No. 29.*" The phrase is repeated; the employee at the commutator hears the notification, and connects jack-knives 7 and 29, by a metallic cord. The boy who hears the call is notified when 7 and 29 have finished; the two pins and the cord are taken off, and lines 7 and 29 are once more at rest. Under this combination the central has nothing to do with calling the second subscriber, and there is not only one operation less, but also a responsibility less.

ELECTRO-BIOLOGY.

DR. DE CYON treats of this subject in a number of *L'Electricien*, and his views on a subject which has been relegated to charlatans, will be of interest to every reader. We give a condensed translation, as follows, of his remarks:

The subject of the electric phenomena which take place in organic tissues occupied the attention of many savants in former times: such as Galvani, Volta, Nobili, Marianini, and Mattenci, and, in our own days, du Bois-Reymond, Helmholtz, &c. Important as electro-physiology is, however, it has not taken its proper place. The experiments connected with the investigation of animal electricity require great nicety in the instruments used, and almost all the discussions on the subject have turned on this point of minute exactness. The idea that the forces which produce the nervous manifestations are identical with the electric forces of the inorganic world continues to gain ground. There is no longer any dispute as to the existence of electric currents in organic bodies; the question dividing the scientific world is, whether these currents are corollaries to nervous action, or the direct cause of such functions. The latter view is that which has most scientific thought in support of it. The pursuit of this branch of electric study is surrounded with difficulties that are easily understood, and comparatively few persons can pursue it. The science had its birth in Italy, and was almost exclusively confined to a few Italian physicists until within the last thirty years.

In 1847, du Bois-Reymond began to give his undivided attention to the study. He still maintains his views, and strange to say, his great opponent, Prof. Herman, of Zurich, is one of his former pupils. Exclusivism has also prevented the advance of this branch of electric science, as it always does whereever the development of knowledge is hampered by schools.

THE PROFITS of the Paris Electric Exhibition amounted to some 400,000 francs. This sum must be employed for a scientific purpose, and it is now proposed to found a laboratory for electrical researches.

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THE BERLIN AND PARIS ELECTRIC RAILROAD.

THE electric railway in Berlin is the object of a great deal of attention and discussion, but the model was exhibited by Siemens and Holske, at the Berlin Exposition of 1879, and at the Brussels International Exhibition in 1880.

The line was single-gauge, and three small cars with room for eighteen passengers were easily drawn. The current was brought to the motor by an isolated rail; the ordinary rails, which did not require to be isolated from the earth, closed the circuit by forming a return wire.

The inventors next endeavored to have an elevated line in Berlin, but the project had to be abandoned on account of the complaints of house-owners, and the opposition of the Emperor.

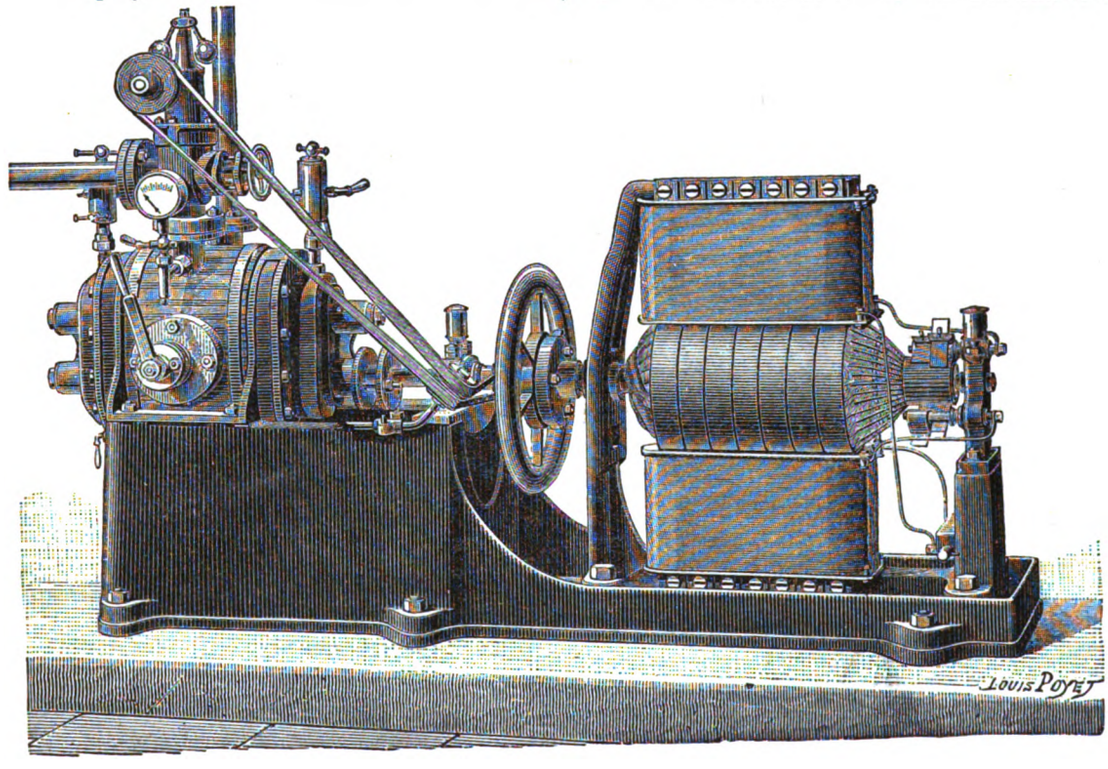

Fig. 1.—Motor and Electric Generator.

The rails were to be isolated from one another; one was to conduct the current, while the other would act as a return wire. The system, which has been since introduced into Berlin, is analogous to it, but runs on the level ground.

This railway, the first public one of the kind, was opened to passenger traffic on May 16. It is 2,500 metres in length, and connects the station of the Anhalt Railroad with the Cadets' Academy. The current is produced by a dynamo-electro machine of Siemens, which is worked *directly* by a steam engine.

The machines (Fig. 1) are mounted on a common frame, thus insuring solidity and good-working. They, in fact, constitute the electric factory, and are situated some 500 paces from the station. Two isolated wires bring the current from the machine on to the rails, which are of steel, and laid on wooden sleepers so as to insure their isolation. The vehicle, a self-moving car, is similar in outward appearance to a tramway car without the *imperiale* (Fig. 2). The system shown in the exhibition was composed of a locomotive and cars. The motor, which is a second Siemens dynamo-electric machine, is placed under the body of the car, and drives the wheels by means of pulleys and steel plates instead of belts.

The wheels are also electrically isolated from the axle, and the engine is placed in communication with the commutator and the rails, by brushes fixed on the frame, and coming into friction with isolated rings which are in electric communication with the wheels.

The car runs backwards or forwards with equal facility, and thus has not to be turned round at end of trip

A simple commutator enables the conductor to work the car as well as the brake and signal bells at each end. One person can thus run the vehicle and collect the fares. There is room for 20 passengers, 12 seated and 8 standing.

The average speed allowed by the authorities is 15 kilometres, and the maximum 20 kilometres an hour. It is very certain, however, that this rate cannot be considered as a limit, and that there is nothing in the system itself which would prevent the cars from being run at a far greater speed.

The peculiar conditions which control the working of electro-dynamic engines, the product of which increases with the speed, would, of course, render it advisable to run at high rates.

The electric railway presents numerous advantages which may be thus resumed: the steam motor is stationary and

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thus there is none of the enormous dead weight of boiler, water, and coal to be carried. The cars themselves, being thus lightened, need not be of so heavy or costly a make.

The building of the road will also be cheaper, the traction expenses will be less, while stopping and starting will be more easy and rapid. The engines, on the other hand, being stationary, can be worked up to full power, and a cheaper combustible used. Natural forces may also be employed in some countries for the traction of cars, and electricity offers the best facilities for doing so. It was suggested some few years ago, that the immense hydraulic power works at both ends of the St. Gothard tunnel, might be employed for lighting the tunnel and driving the locomotives. The success of the Berlin experiment should attract renewed attention to the project.

Returning to the advantages offered by electric railroads in cities:—There is neither noise, steam, smoke, or sparks. The road may be two-gauged, and several trains can be run simultaneously on the same line, or on two lateral lines. As the steam engines are cheaper in proportion to their power, the same engine shop can work a whole system of roads within a certain radius, and distribute electricity for illumination and motive power. It is especially by having operations on a large scale that the application of electricity can be multiplied and cheapened.

The gas-house must serve as a model for electric works. The distribution of electricity is not more difficult to-day than was that of gas in its infancy, and the same success awaits it.

The electric railways, as exhibited in the Paris Exposition of Electricity, presented some points of divergence from the Berlin arrangement. The rails were on the ground level and not isolated, and therefore could not be used for bringing the current. As metallic communication might be established between the rails by any iron instrument in the hands of a wayfarer, the system of conducting rails could only be used on lines shut off from the public, or on underground or elevated roads. The current has to be brought to the carriage by a conductor, placed at a certain height above the road, and supported by brackets along the way. The carriage can be always placed in connection with this conductor by a collector of a special form, while the rails will only be used as a return wire. This ingenious device overcomes the difficulties which were in the way of electric traction for tramways.

Some experiments, which are reported to have been very successful, have lately been made with electric accumulators, placed in the cars. The trial was made under the supervision of Messrs Philippart, Faure and Reynier.

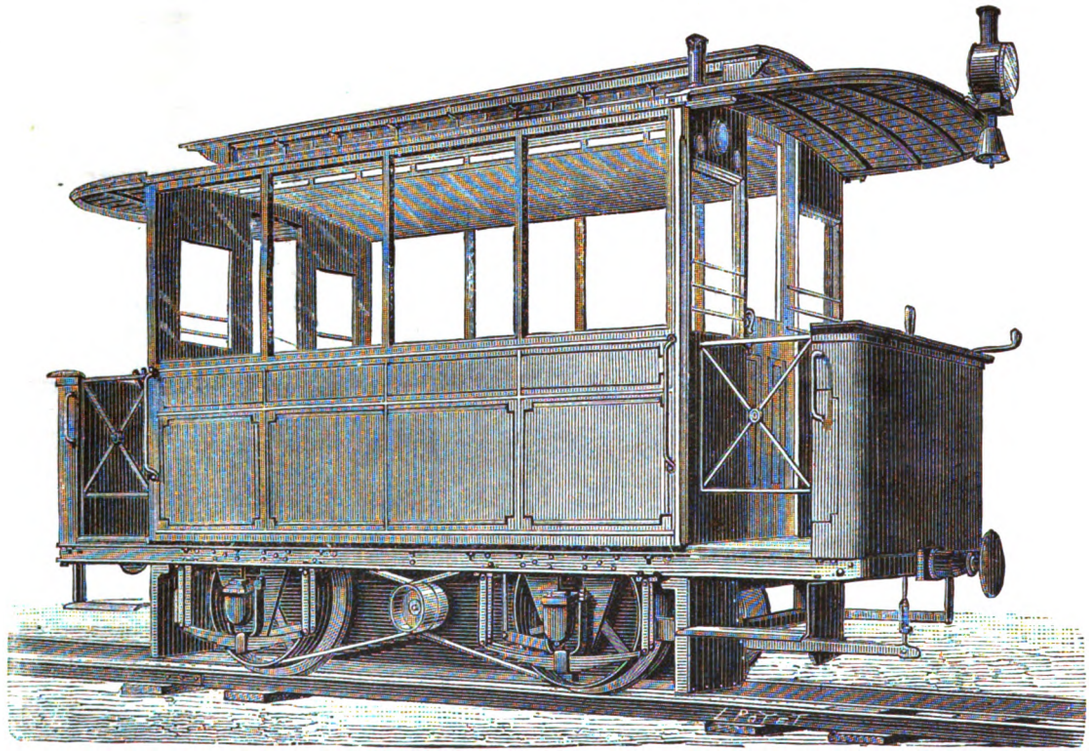

Fig. 2.—Electrical Railway of Gross-Lichterfelde. Automatic Carriage with 20 Seats.

There are six systems of electric traction at present in use, or being experimented with, viz:

1. The small traction machine of Siemens with an isolated centre rail, which was worked at the Berlin and Brussels Exhibitions.

2. A self-moving carriage on isolated rail and elevated road. This is an idea of Siemens, which has been temporarily abandoned.

3. The Gross-Lichterfelde Railway. An auto-mobile car with isolated rails, running since May 16, 1881.

4. The tramway shown at Electric Exposition in Paris, 1881. Auto-mobile car, with road on ground level, and conductor suspended above the way.

5. Electric tramway with accumulators. System of

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Philippart, Faure and Reynier. Auto-mobile car, having in it its own electric store.

6. The Tricycle, built by M. Trouvé. It is worked by the secondary piles of Gaston Planté, and by a Siemens coil motor, with Trouvé's improvement.

MICROPHONES AND MICROPHONIC SPEAKERS.

THE MICROPHONE is simply a telephonic transmitter of a peculiar form, but it owes its name to the results which can be obtained by it.

It is really an amplificator of mechanical vibrations of weak intensity, which it changes into undulatory currents. These currents are sent into a telephone receiver, where they often produce sonorous vibrations of far greater intensity than the original. It plays the same part in acoustics with relation to feeble sounds that the microscope does in optics with regard to small objects.

We must first, however, describe the apparatus of Mr.

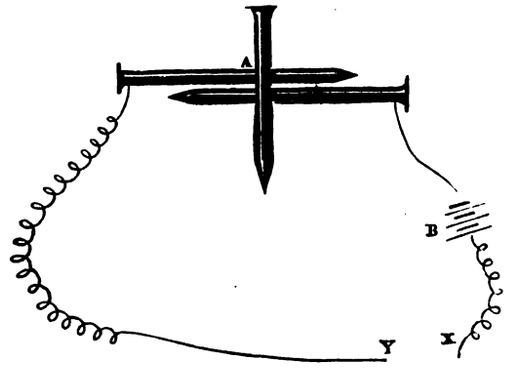

Fig. 1.—Elementary Microphone.

Hughes when the incredible results obtained from it will be more easily understood.

The simplest apparatus used by Mr. Hughes in his experiments is shown in Fig. 1. Two nails A are fixed in a small horizontal board, at about a millimeter (0.039 inch) from each other. The wires X and Y, which are attached to the nails, lead to a pile B, and to a telephone, so that the only break in the circuit is formed by the space between the nails. By placing a third nail across the two first the current passes by the points of contact of the two nails, which make an imperfect contact, to which fact the apparatus owes its sensitiveness. It is a perfect telephonic transmitter—words spoken, or airs sung over this little nail, which dances, as it were, over the two others, at the sound of the articulation or note emitted, are immediately transmitted to the receiver at the other end of the line, and reproduced with astonishing clearness and force. The effect is heightened by using carbon rods.

The most delicate apparatus invented by Prof. Hughes, however, and that which, with a few slight modifications, has remained the *standard* microphone, is represented in Fig. 2. It is formed of a small charcoal crayon A and pointed at both ends. It is lightly held in a vertical position between two cups hollowed out of two small carbon blocks C C, which are fixed to a thin sounding-board. This last is laid on a firm plate D. The blocks CC are connected with the pile, and the line wire that leads to the telephone, by the wires X and Y. This instrument, thus rough and simple in its outlines, is, yet, of wonderful delicacy.

Not only words and musical notes, but the faintest vibrations, and even imperceptible sounds, are converted by it into sonorous repetitions. The slightest stroke on or touch against the plate will produce a loud, grating sound in the telephone. If an artist's brush is drawn across the plate, or a small tuft of cotton let fall on it, there will be a regular din set up in the receiver. The passage of an insect, or a fly, over the plate D, (Fig. 3), is heard with perfect distinctness by a person on placing his ear at the telephone, although several miles from the transmitter.

EFFECTS PRODUCED IN THE MICROPHONE.—It is now easy to understand the slight differences that exist between Edison's carbon transmitter, and the microphone in the simple form given to it by Mr. Hughes.

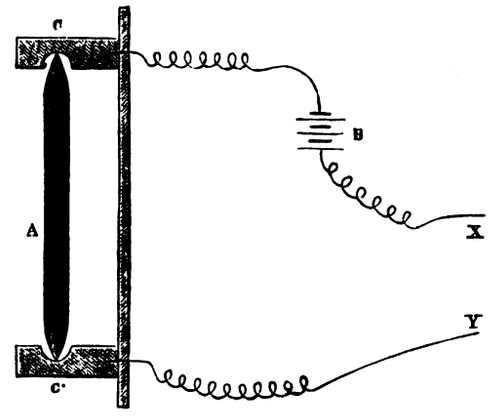

Fig. 2.—The Hughes Microphone.

The telephonic or microphonic action is produced in both instruments by the *variations of electric resistance*, which result from the vibrations that are communicated to the transmitter.

In Edison's carbon telephone these vibrations act on a plate, that produces variable pressures on a disk. In Hughes's microphone, the vibrations change the points and surfaee of contact; one is arranged for transmitting words only, while the other is more specially adapted for sending feeble sounds.

There has been every reason, therefore, from the beginning to consider the inventions of Edison and Hughes as perfectly distinct, both as regards the methods employed, and the effects produced. A whole series of instruments have since bridged over the dividing line between the two original inventions. It is not easy to draw distinctions between the two systems, with the new transmitters of Blake, Boudet, Paris, Ader, &c., before us, but all the microphones and microphonic speakers can be designated under the generic name of *carbon transmitters*.

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If we observe what takes place in a *microphonic contact* we can easily comprehend how the Hughes microphone can transmit the feeblest sounds by amplifying them. Let us take, for instance, the insect crossing the microphone board (Fig. 3).

Each step of the insect gives rise to a slight mechanical movement, which, although it is not of a nature to make itself felt by the ear, still acts on the microphonic contact, displaces and changes the points of contact; and all this is manifested by variations in the intensity of the current. These mechanical displacements are rendered all the more easy by the uncertain equilibrium of the vertical carbon crayon. If this crayon is placed horizontally, the apparatus will lose a great deal of its delicacy.

From a philosophic point of view the Hughes instrument is very imperfect, from the fact that it does not act *proportionally* to the vibrations it receives. Very weak vibrations are greatly amplified, while stronger ones are reproduced with their real intensity, and powerful sounds produce only a diminished intensity. The apparatus is thus similar to a microscope that enlarges small objects and dwarfs large ones. For want of instruments to determine directly the *intensity* of sounds, at present we can only *measure* their height and *appreciate* their intensity and timbre. It is impossible to tell how those microphonic sounds are taken up.

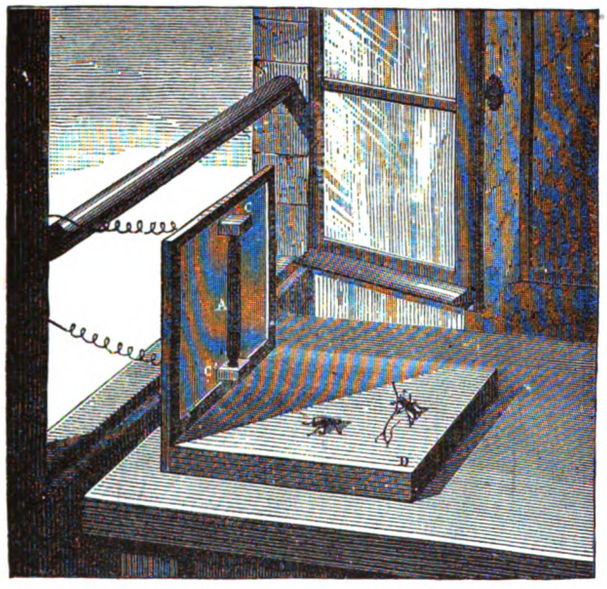

Fig. 3.—The Hughes Michrophone. Hearing at a Distance Insects Walking.

THE HUGHES TELEPHONE ON DUCRETET'S MODEL.

This small model of a microphone reproduces most of the experiments (Fig. 4). A small black-lead, or crucible carbon crayon, is pointed at both ends, and kept in a vertical position between two crucible carbons DD′. The bearer of the upper cup D, is so arranged that the equilibrium and the play of the crayon between the cups can be quickly regulated, and consequently the sensitiveness of the microphone. The two cups are in direct communication with the two boundaries BB′. The whole is fixed to a small board and a wooden upright P. Two india rubber tubes, underneath, serve as feet to the board, and isolate any foreign vibrations. A slip of emery paper provides a rough surface E, for producing frictions to be transmitted by the instrument.

A pile of two or three Daniell or Leclanché elements, and a telephone T, *placed at a distance*, form a complete circuit, in which is comprised the crayon C, with imperfect contacts.

M. Trouvé has constructed a very portable model of a microphone, by inclosing the carbon crayon in a small cylindrical box of black-dyed india rubber.

Messrs. Crossley & Maiche have constructed microphones with multiple contacts, just as M. Navez has invented a carbon transmitter with several disks, but the increase of those imperfect contacts, when too multiple, is open to several objections.

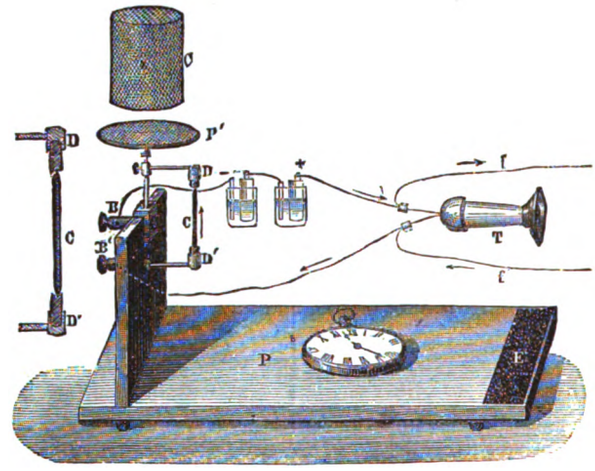

Fig. 4.—Ducretet's Model of the Hughes Michrophone.

MACHINERY FOR ELECTRIC LIGHTING.

LIGHTING by electricity has already proved to be of great advantage to the machinery industries. Gas works are not good customers for machinery, but steam engines, boilers, and dynamo-electric machines are essential to electric illumination. Dynamos are usually built at the shops of the electric-lighting companies, but steam engine builders and boiler makers are experiencing a lively demand for this purpose alone. But electric lighting is, as yet, in its infancy, therefore what may we expect in a few years, when the lighting of streets and public buildings by electricity shall have become a common practice? The number of orders already received by some engine builders to supply motors for dynamo machines is astonishing, but the rapid increase of such orders is even more astonishing to those who have not studied the situation.—*American Machinist.*

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THE CUMMING PERIPHERY CONTACT TELEGRAPH KEY.

ONE of the interesting novelties which received a medal of award at the Paris Electrical Exposition, is a telegraph key having peripheral contacts, the invention of Mr. George Cumming, of New York.

The device consists in the placing of two wheels or disks, swinging one upon the other, at right angles; one disk attached to the lever and the other in the anvil. The electrical contact is attained on the rims of tires of these platina disks, instead of by the two wire points in general use for telegraph keys. These said disks are capable of a thousand surfaces by adjustment. The wheels are firmly held in place by small set screws working on the axles.

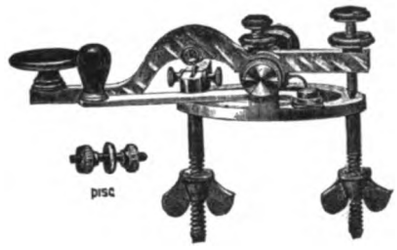

Fig. 1.

This attachment can be applied with equal advantage to all electrical machinery, and would be a much desired improvement for the correct transmission of time signals by means of electric clocks, etc.

The advantages claimed for this new form of electrodes particularly as attached to the key, are :

1. The least possible contact surface—a mere geometrical point—which produces perfect electrical connection.

2. Circular surface of the rim: Thus preventing dust from accumulating easily at the point of contact and breaking circuit.

3. Adjustability of the electrodes: For, if through any unforeseen accident connection should be arrested, both wheels, having a thousand possible points of contact, can be changed in an instant by turning each slightly on its axis to a new and bright surface.

4. No lateral motion: The electrodes connect firmly and perfectly, so that the trunnion can be screwed tight without affecting the correct working of the key.

5. Close contact: For the same reason the contact can be so regulated, if desired, that no lost vertical motion need be perceptible, thus giving a soft velvet stroke.

6. No jar: The system of wheels and axles being to a certain extent elastic, which makes it possible to work the key all day without any lost motion to fatigue the hand or try the nerves.

The two disks being placed at right angles to each other, the connection between the two is only a needle point of surface. At the same time the signals are given with great precision and delicacy of stroke. The infinitesimal surface of the peripheric contact at right angles as a conveyer of electricity, had not hitherto been discerned or adopted till discovered by the inventor of this key.

The theory on which the "Cumming periphery contact" is based is, that two circles can meet at but one point. Crossing them at right angles reduces this point and rounding the edge of the wheels or disks, if used mechanically, the contact is reduced to the minimum. In the subjoined cut, J K represent two ordinary wire points magnified. A B is intended to show that, however true the faces are filed, they can meet but at one point as at C. D and E represent this contact on one edge at *t*. It will be seen that the currents in passing around to this point must mutually attract one another and tend to jump the intervening space, and the nearer G and H are to each

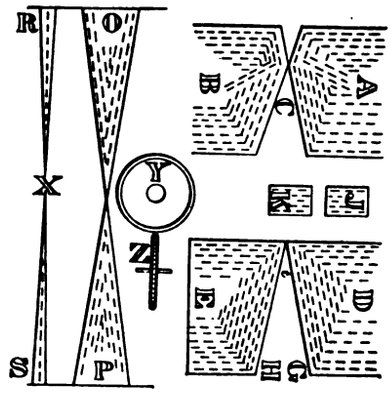

Fig. 2.

other without actually touching, the more liable the key or other telegraphic instrument is to stick. O P and R S are two sharp cones in which it is seen that the currents flow naturally towards the apices without any interference. In Y Z is seen the periphery contact at right angles which is the nearest approach to the needle point and therefore the most perfect; it being a firm, delicate stroke that can be adjusted to the 1-1000 of an inch play without any sticking even under an intense dynamo battery.

AT A RECENT MEETING of the New York Electrical Society Mr. Charles S. Small, assistant superintendent of the Gold and Stock Telegraph Company, read a paper on "The Novelties of the Paris Electrical Congress. After praising Edison for his important, numerous and varied exhibitions; Maxim for his powerful arc lights; and George Cumming for a new telegraphic key with peripheral contact; Mr. Small proceeded to describe the novelties. A microtasimeter was explained, which is so delicate that it will measure the calorific rays emitted by the fixed stars. An electromotograph, somewhat similar to the telephone. was said to contain greater intensity than the telephone. Electric motors for balloons were described, which possess the advantage of having the balloon carry its own motive power. Uniform time-keeping by the electric current, photography by the aid of the electric light, and an automatic weather-recording apparatus were explained, after which several members of the society discussed the merits of the paper presented.—*Operator.*

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

MR. EDWARD WESTON, of the Weston Electric Light Company, recently delivered a most interesting lecture at the above Institute, on the subject of the electric light, for a synopsis of which we are indebted to the *N. Y. Evening Post.*

Mr. Weston first explained and illustrated, by experiments, and photographs projected upon the screen, the attraction and repulsion of magnets, and the arrangement of iron filings along the so-called lines of force in the vicinity of magnets. He then showed that coils of wire (called solenoids), through which an electric current was passing, exhibited properties similar to those of a magnet, and that these properties were intensified by the presence of a piece of soft iron within the coil. The last-described arrangement is called an electro-magnet, and is the basis of all modern dynamo-electric machines.

It was then shown by experiment that if a coil of wire was moved in the field of an electro-magnet in such a way as to cut the lines of force of the magnet, a current of electricity would be produced in the coil, as was made evident to the audience by means of a galvanometer. The current produced will be stronger when the lines of force are cut at right angles, weaker when at other angles, and a certain amount of resistance will be experienced by the person moving the coil. To show that such work is done, a flat piece of copper cut in the form of an arc was allowed to swing between the poles of an electro-magnet. When no current flowed through the coil of the magnet the copper swung freely; when the current was allowed to pass, the copper was immediately checked in its motion and moved slowly down to its position of rest, experiencing the resistance before alluded to. Thus it is shown that currents of electricity can produce magnets, and by means of magnets currents may be generated—facts which render the dynamo-electric machines possible.

Mr. Weston then described various of the earlier forms of machines for generating currents of electricity — the Pixii, Saxton, Henley, Alliance, etc. In these machines permanent magnets were used to produce the magnet field in which the armature was rotated. The substitution of electro-magnets for the permanent magnets marked a great advance in the construction of the machine. Professor Farmer, of Boston, was one of the earliest workers in this line. The Siemens armature and the Wilde and Gramme machines were described from photographs. A small machine of the Weston form was exhibited upon the table and explained briefly. One important feature is the cutting the iron core of the armature into thin plates at right angles to the axis of rotation of the armature, to avoid the loss due to induced currents in the core itself.

Some of the sources of loss in the dynamo machines were then pointed out. These are chiefly in the resistance of the wire wound upon the armature and in the induced currents in the iron core (eliminated as just described in the Weston machine). The heating effects of the current were experimentally shown by passing the current through a chain of platinum and silver links, the former becoming luminous, owing to the greater resistance of the material while the silver remained dark. The work lost in the dynamo machine is thus converted from electrical currents into heat, and appears in that form in various parts of the machine. The heating effect of a current is proportional to the resistance of the conductor through which it passes, to the square of the current, and also to the mass, or amount of material, in the conductor. This law was also experimentally demonstrated, and the last point specially enforced as having an important bearing upon the subdivison of the light.

The principle of the voltaic arc and of the regulators now used in this method of lighting were explained; and that of the incandescent lamp next referred to. The latter consists of a strip of carbon inside of an exhausted glass globe. The ends of the carbon are connected to platinum wires leading out through the glass. The current is sent through these wires and heats the carbon to incandescence. These carbon strips are somewhat the form of a letter M, and are formed from cardboard, which is heated in a retort until thoroughly charred or carbonized. In that form, however, they are so irregular in resistance that upon passing the current through them they appear brighter at some parts than at others, and would soon burn off. The next treatment is to admit into the exhausted space in which the carbon is placed a little vapor of gasoline. The carbon is then heated by the current of electricity, and almost instantly the carbon from the gasoline vapor is deposited upon the hottest parts of the carbon strip until this becomes of a uniform brightness throughout. Seven lights of this sort of about twenty-five candles each can be obtained per horse-power, sometimes more than that.

The opposition that has been raised to electric lighting, on account of the danger to life and property, has been much exaggerated. With machines producing the alternating current such as is required for the Jablochkoff candle, there is considerable danger for those who have to work upon the lights; but with machines of the Gramme and Siemens type there is scarcely any danger. A person can take hold of the poles of one of the ten-light Weston machines without discomfort, and even of the twenty-light machines without danger. Where a ground circuit is used the danger is somewhat increased. There can be no danger of fire from the overheating of the wires in the arc system, because the machine used would be incapable of producing sufficient current to heat the wires with the belts and power as ordinarily applied. The dangers are somewhat greater with the incandescent system, but can easily be avoided by proper arrangement of the wires. The voltaic arc light, with due precautions, is the safest light known to-day.

The society's room was lighted at the close of the lecture by the Weston arc lamps, and three of the incandescent lamps were shown in operation, giving about twenty candles each. The necessary currents for these and other experiments were obtained from two of the Weston dynamo-electric machines in the mining laboratory of the Institute.

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THE ELECTRIC BOAT.

THE first trial of an electric boat was made on the Neva as far back as 1839. The idea originated with Jacobi, who was supported by the Russian government; but the experiment was only partially successful, and was abandoned until quite recently. The motor employed by Jacobi was excessively heavy, and, although it was furnished with 128 Grove piles, it supplied a comparatively feeble motive power. M. G. Trouvé, who is a well-known maker of scientific instruments, has built a small electric boat, which was tried last summer on the Seine, near the Pont Royal, and which excited great curiosity.

The electric motor was applied to a small yawl, *Le Telephone*. Two electric motors, placed at the helm, communicated the power by means of a Vaucanson, or band chain, to a three-branched screw. The gearing is greatly simplified by this ingenious arrangement, while steering is facilitated; for a turn of the helm causes the axis of the screw to turn at the same time, while the oblique action of the latter assists the rotatory motion. The electric current is conveyed to the motor by two flexible metallic cords, which are covered with cotton. They serve at the same time to work the helm. Handles are attached in the form of a commutator, so that the electric current can be interrupted or restored at will. The two motors are small dynamo-electric machines, with Siemens coils and Trouvé's modification. They are absolutely independent of each other, and act together, or separately, according to the rate of speed required. Two bichromate of potash piles, with large surface and six elements each, feed the motors. The weight of the boat, with the piles, motors, and three passengers, was 350 kilos. It ascended the Seine at the rate of one meter per second, but came down the current with a speed of two meters; the rate of the current itself being about 20 centimeters. But, although the whole device is very ingenious, and the experiments interesting, it must not be concluded that the problem of running pleasure boats has been solved.

Even supposing that Trouvé's electro-motor gives a satisfactory product (and experiments now making will soon enlighten us on this point), yet it is evidently radically wrong in the electric source itself. The bichromate pile is very active for a few moments, but is then rapidly polarized. The experiments lasted only a few minutes in each case, so that the elements had to be taken out of the liquid at once to facilitate depolarization. We question very much whether an equable and continuous power can be obtained during several consecutive hours. The electric boat is at present only another interesting exhibit of the inexhaustible resources and applications of electricity. Further experiments will be made in the Bois de Boulogne with a small boat specially built by M. Trouvé; but it is only when a strong, cheap, and constant pile will be found that the invention will be of practical utility. To discover such a pile, however, is the great problem in electricity.

THE DIOSCOPE.

BY aid of the dioscope, an ingenious instrument brought for the first time to public notice during the Parisian Electrical Congress, patrons of the drama, who are reluctant to leave their comfortable firesides, and temporarily revoultionize all their domestic arrangements, in order to attend theatrical performances *in loco*, will henceforth be able to see as well as hear their favorite operatic and histronic artists without moving a yard from home. The apparatus consists of a small "objective" lens, fixed in a position commanding the stage of no matter what theatre, and connected by an electric wire with a diminutive white glass plate, which may be framed and set in the panel of a private drawing-room, however distant from the playhousse in question. Total darkness having been obtained in the room furnished with a dioscope, a perfect picture of the stage, its scenery, actors and so forth, faithful in color and absolutely reproducing the whole performance, will become visible upon the surface of the glass plate. Supplemented by a telephone communicating with the theatre, the dioscope will therefore enable its owner to spend his evening at the opera in dressing-gown and slippers, if such be his ideal of comfort, seated in an easy chair within hail of his "lait de poule et bonnet de nuit."

ELECTRICITY IN LIGHTHOUSES.

THE annual report of the Lighthouse Board recommends the introduction of electricity in some of the "first order seacoast lights." Congress, it is to be hoped, will enact the necessary legislation. The improvements in electric lamps, burners and all the agencies for generating electricity make the experiment safe. In fact, the question of the supply and regulation of light in this way is no longer one of experiment. Electricity has supplanted every other form of artificial light in some of our largest business establishments. In many cities and towns it has driven out gas for the purposes of street illuminations, and will do so in New York as soon as the necessary machinery can be arranged. The adoption of the electric light would be a very great benefit to mariners. There are atmospherical conditions under which it can be seen when all other lights are invisible. The government should keep up with the improvements of the time.—*N. Y. Herald.*

IT IS INTENDED to hold at the Crystal Palace, London, in December next, an international exhibition of electricity, at which all the existing systems of lighting will be represented. The short days of the winter months will, it is considered, afford the most favorable period of the year for such a display. At the same time it is proposed to form a collection of electrical apparatus generally, including the various forms of telephones, Fauré's and De Meriten's secondary batteries, and a large variety of scientific objects concerned in the production or employment of electricity and magnetism.

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SPARKS.

THE GAS HOUSE must serve as a model for electric works; the distribution of electricity is not more difficult to-day than was that of gas in its infancy, and the same success awaits it.

The city of Montreal is now being lighted with electricity.

THE BRITISH ELECTRIC LIGHT COMPANY are about establishing at Liverpool, for the lighting of that city, a manufactory of electric machines on a larger scale, it is said, than any yet constructed in England. This company has submitted a method for lighting the principal streets, and, after experiments recently undertaken on a grand scale, have established sixty-three lamps, which illuminate for a distance of about three miles the principal central avenues.

The lamps are placed upon supports of iron of various heights, from 20 to 50 feet, according to circumstances.

A portion of these lamps are fed by underground conductors, while the rest are furnished with the ordinary aerial circuits.

The station of the generating machines is situated at the Princess Docks, and is already furnished with Marshall motors of a power of twenty horse-power, and one of Ransome & Sims' machines of the same power.

There are three series of eight alternating generating machines. Six of these machines are Gramme style H, capable each of lighting fifteen lamps of two thousand candle power each. The two others are smaller machines.

One engine of twenty horse-power is sufficient to furnish the motive power necessary for the sixty-three lamps, but there is another one in case of accident; the generating machines are also arranged in duplicate.

AT MELBOURNE, AUSTRALIA, the electric light has been adopted for lighting the Alfred graving dock.

ELECTRIC LIGHTING has begun to be adopted in Holland, at the Hague, Utrecht, Amsterdam, and Rotterdam.

THE TELEPHONIC SOCIETY is about to introduce at Havre in its service, messengers or commisioners for errands, or to carry small packages, telegraphic dispatches, samples, &c. This service is placed at the disposal of subscribers at the price of 0.50 franc the errand for ordinary routes comprised within certain limits. The answer is returned to the house for 0.25 franc. Outside of these limits established in advance by the company, the above prices are doubled.

IT IS STATED that Niandet & Duchateau, managers of the "Compagne Internationale des Téléphones," are about to sign an agreement for the purchase of the Gramme patents relating to the application of electric engines to industrial purposes. The Telephone Company will form a new company with a capital of ten million francs, and which will, it is said, have the most encouraging support.

THE *New York Herald's* cable dispatch from Vienna on the subject of the origin of the late awful disaster at the Ring Theatre, says: "Those who could escape from the galleries perished in the passages and on the narrow stairways, which, by reason of one man alone in the entire theatre doing his duty and turning off the gas, were left in the blackest darkness. It is now ascertained this man was the only one who stuck to his post, yet he cut off the escape of many scores. It is now known that the fire originated with the gas which lighted the "sky borders." In another dispatch, same date, it says: "About ten o'clock the gasometer exploded, the roof fell, and the whole place was reduced to a wreck." Another dispatch on this subject in an evening paper, says: "One of the firemen, who had charge of the gas, thinking that an explosion had occurred or would occur, turned off the gas at the meter, plunging the theatre into total darkness."

SIEMENS'S TRAMWAY, at the Electric Exposition, carried 84,000 passengers during the three months it was running.

THE CAUSE OF THE FIRE a few days ago at Morristown, N. J., was the explosion of a so-called gasoline apparatus.

MR. BEDE, who was one of the first to introduce the telephone into Belgium, is about preparing a book entitled "History of Telephones."

IF AN ELECTRIC APPARATUS for sending an alarm of fire to the nearest station, had been in operation at Vienna, as is obligatory in the Berlin theatres, another factor in the unheard-of proportions of the calamity, would have been eliminated.

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ELECTRIC BALLOONING.

THE Balloon is, so far. the only apparatus with the aid of which man can ascend into the atmosphere. Possibly in the future, when we shall be in possession of motors now unknown, aëroplanes, helices (*screw-propellers*), even mechanical birds will traverse the aërial ocean. We will never pronounce the word *impossible*, but we do affirm that at present, with our existing resources, physical and mechanical, there is no reasonable hope of attaining anything of the kind.

We see ignorant inventors fitting sails to spherical balloons, never reflecting that such aërostats move with the mass of the air in which they float; quite oblivious, too, of the fact that for a balloon moving horizontally there is no wind, and that the sails it carries cannot be of any service, for no breeze fills them. Others propose the use of oars worked by hand, and suggest all sorts of preposterous systems, in which the dreams of the imagination take the place of a true scientific basis.

We have to come down to the year 1852 in order to find any experiments of capital importance tending toward a

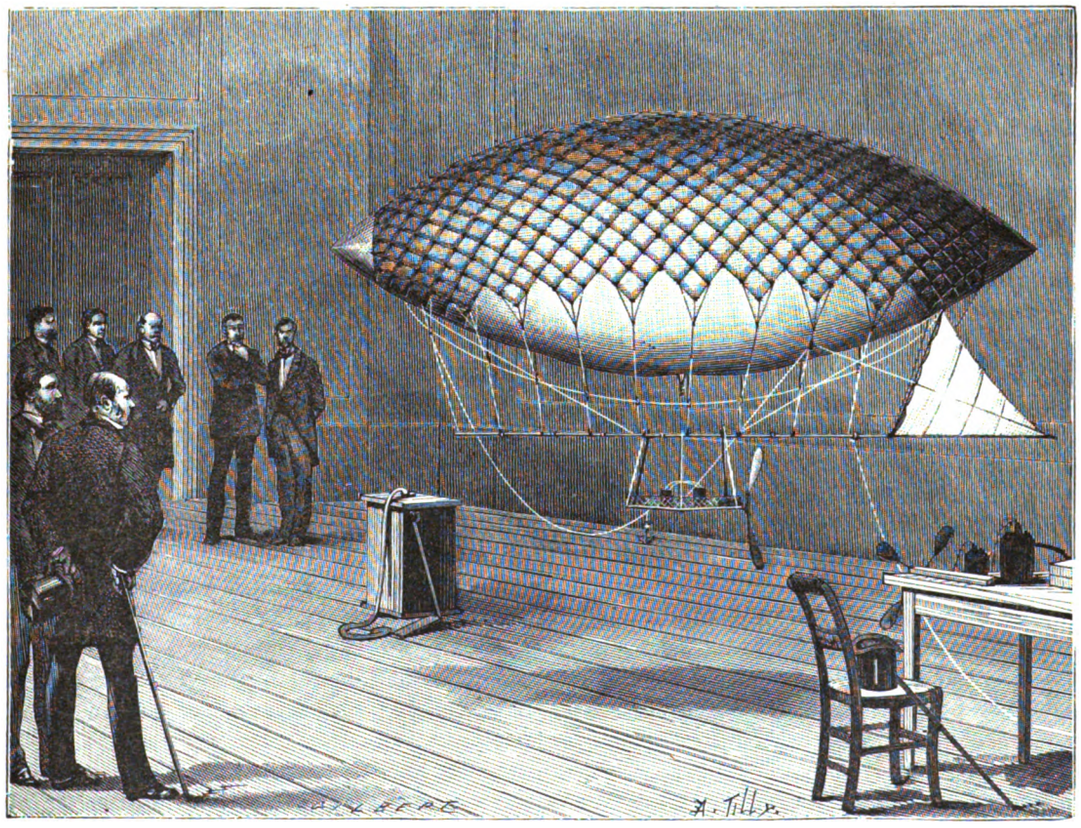

FIG. 1.—GASTON TISSANDIER'S ELECTRICAL AËROSTAT (SMALL EXPERIMENTAL MODEL).

If, therefore, we would direct our course through the atmosphere, we must recur to the balloon, and must take it as it is, with all its imperfections.

Let us see what we may expect in the way of aëronautic apparatus.

From the time when balloons were first introduced, the one great problem has been, How to control their movements—how to *direct* them; and many contrivances have been suggested for this purpose, most of them inadequate, many of them even ridiculous.

solution of the problem of directing aërostats—experiments made by a great mechanician who was destined to lay down the true principles of aërial navigation by balloons.

In 1852 my preceptor and friend, Henri Giffard, the future inventor of the injector which to-day bears his name, after a prolonged study of the great problem, for the first time clearly discerned that, in order to direct a balloon, its spherical form had to be changed. "What is to be done," said this accomplished engineer, "to reduce to a minimum the resistance of the air; in other words, to

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facilitate as much as possible the passage of this mass through the atmosphere? The answer is obvious: we must give to the volume of gas the greatest possible length in the direction of its motion, so that its transverse diameter, on which in a great measure depends the resistance, shall be reduced in the same proportion."

As early as the year named, Mr. Giffard constructed an oblong aërostat of 2,400 cubic metres (84,756 cubic feet) capacity. The first air ship was 44 metres (about 145 feet) long, and 12 metres (39.37 feet) diameter in the middle. It was enveloped in a netting that supported a horizontal bar of wood, which carried at one end a sort of triangular sail, serving as a rudder. The boat which was fastened to the bar contained a small high pressure steam-engine with its appurtenances. This engine worked a screw which was capable of making 110 revolutions per minute. The motor was of three horse-power, or equal to the energy of about 30 men. The aërostat was inflated with illuminating gas.

On the 26th of September, 1852, it made its first ascension under the direction of Mr. Giffard. Having reached a certain elevation, it was made to turn round and round under the action of the rudder, to remain absolutely motionless in the atmosphere, to move in a direction sensibly different from that of the wind, etc. The speed in all directions was at the rate of from seven to ten feet per second, though the velocity of the wind on the day of the experiment was considerably greater. Had the trial been made on a perfectly calm day, it could certainly have been steered in every direction.

In 1872 Dupuy de Lôme made a similar experiment with an oblong aërostat of upward of 3,000 cubic metres (105,945 cubic feet) capacity, with a screw and rudder. This aërostat, containing Messrs. Dupuy de Lôme, Gabriel Yon and Zédé, with ten men to turn the screw, deviated slightly from the direction of the wind. But the crew of ten men did not supply sufficient motive power—indeed they hardly produced one horse-power of steady force.

But why should not Mr. Dupuy de Lôme have substituted for this crew of ten men a steam-engine which, weight for weight, would have given ten times as much force? Probably for the reasons we shall presently indicate, and these are in our opinion the very reasons that have hitherto discouraged all attempts at directing aërostats by steam power.

Steam power in aërial navigation is open to the following objections:

1. It involves a furnace. Now a fire burning beneath a balloon filled with hydrogen, the most inflammable of gases, is a constant source of danger. True, it might be screened by a wire-cloth, but still there would be danger occasionally from sparks and cinders. A fire beneath a balloon filled with hydrogen is like a lighted match beneath a barrel of gunpowder.

2. A steam motor is ever losing weight as it continues to work. It gives out to the air some 22 pounds of water vapor per hour per horse-power; it consumes about 9 pounds of coal per hour per horse-power. If the balloon is equilibrated in the air, this unballasting will tend continually to make it rise; and to prevent this, gas will have to be let out continually. Of course the steam might be condensed and the gas from the balloon could be used as fuel, but that process would necessitate the employment of complex apparatus, while at the same time it would not diminish the danger from fire.

We do not assert that good results may not be attained with steam motors, especially the light motors constructed nowadays, but we do hold that the employment of such motors is always dangerous.

So much premised, we come now to our scheme of an aërostat to be directed by electricity, and here we reproduce a few passages from the note we recently presented to the Paris Academy of Sciences:

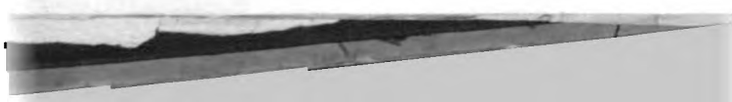
"The improvements lately made in dynamo-electric machines have suggested to me the idea of applying such machines to the directing of aërostats, in connection with Mr. Gaston Planté's secondary piles which, though their weight is comparatively little, store up a great quantity of energy.

"Such a motor, attached to a screw, possesses considerable advantages for the aëronaut: it requires no furnace, and hence does away with the danger of fire beneath a mass of hydrogen; its weight is a constant quantity, and there is no giving off to the air combustion products, and consequently no continuous unballasting of the aërostat, causing it to ascend. The machine is set in operation with incomparable facility, by the simple contact of a commutator.

"I have experimented with a small oblong aërostat, pointed at both ends—about 11½ feet long and 5 feet in diameter at the middle. This aërostat has a capacity of about 2,200 litres (581 gallons). Inflated with hydrogen, its ascensional force is two kilograms (4.41 pounds).

"Mr. G. Trouvé has constructed for me a small dynamo-electric machine, Siemens pattern, weighing 220 grams (8 oz. nearly), the shaft of which is made to drive a very light screw of two blades, 0.40 metre (about 15 inches) in diameter. This motor is fixed in the lower part of the aërostat, with a secondary element weighing 2.8 pounds. The screw makes 6½ revolutions per second; it acts as a propeller; and in still air it gives to the aërostat a velocity of one metre (39.37 inches) per second for upward of 40 minutes. With two secondary elements of high tension, weighing about 2 pounds each, I can attach to the motor a screw 0.60 meter (23.62 inches) in diameter, which gives to the aërostat a velocity of about seven feet per second for ten minutes. With three elements the velocity rises to about ten feet."

Since the time of these earlier experiments I have had constructed by Mr. Lachambre, aëronaut, a second small model, 4 metres (13 feet) in length, which figured at the recent Electrical Exposition in the Palais de l'Industrie. The little electric balloon, inflated with hydrogen, traversed the width of the nave of that building, guided simply by a stretched wire. The model shown in Fig. 2 may be seen in operation weekly at the Conservatoire des Arts et Métiers.



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The weight of the Planté accumulators placed in the boat, and of the motor, is never quite 2 kilograms (4.4 pounds); that is to say, it is always less than the available ascensional force possessed by the aërostat when inflated with hydrogen. The screw, which is 30 centimetres (about one foot) in diameter, and which is operated by a small Trouvé motor weighing 220 grams (7.76 oz.), can easily overcome the resistance of the atmosphere, and give to the aërostat a velocity varying as the batteries rise in quantity and in tension. Experiments have shown that the little aërostat has considerable speed, considering its small volume. The balloon is provided with a rudder aft, by which it might be made to move to the right or to the left. In the Conservatoire the apparatus is attached to a circular *manége*, and hence does not require to be steered.

Let us now see what results might be obtained with a large aërostat, constructed according to this model.

Under existing conditions, a dynamo-electric motor weighing 300 kilograms (about 660 pounds), with secondary elements weighing 900 kilograms (1984 pounds), can easily give 5 horse-power. It would be easy to carry this material, weighing in all 1200 kilograms (2,645 pounds), in an oblong aërostat of 3,000 cubic metres (about 106,000 cubic feet) capacity, filled with hydrogen — such balloons as those used by Giffard in 1852, or by Dupuy de Lôme in 1872. The aërostat might be 40 metres (131 feet) long and 18½ metres (60.7 feet) in diameter at the middle. Its ascensional force would be about 3,500 kilograms (7,716 pounds). Thus there would remain an ascensional force of more than 1,000 kilograms (2,204 pounds) for passengers and ballast. In a calm atmosphere such an aërostat would travel 20 kilometres (about 12½ miles) per hour, and with the atmosphere in motion it could deviate from the course of the wind. True, it could keep in operation only for a limited time—a few hours, perhaps—but it might serve for making test experiments that would be decisive. The results obtained will be still more favorable were we to employ a dynamo-electric motor and secondary piles of very light construction. Thus, with an equal weight, we should have a far larger amount of energy.

We intend, at no distant day, to undertake the construction of such an aërostat. It will be inflated with hydrogen and sheltered beneath a great shed. When the air is calm it will issue from its refuge and rise into the atmosphere, with its motor and its accumulators. To set it in operation it will be necessary only to touch an accumulator. It will make excursions overhead Paris, and will return again to its starting point. We propose to begin our preliminary experiments during the present year.

If, as we confidently expect, these experiments are successful, the first step, however inconsiderable it may be, will have been taken. But it must be borne in mind that our purpose is only to navigate the atmosphere under certain determinate conditions, *while the air is calm*, and only *for a limited time*.

Fulton's steamboat was a very different craft from the steamers of our day.

GASTON TISSANDIER.

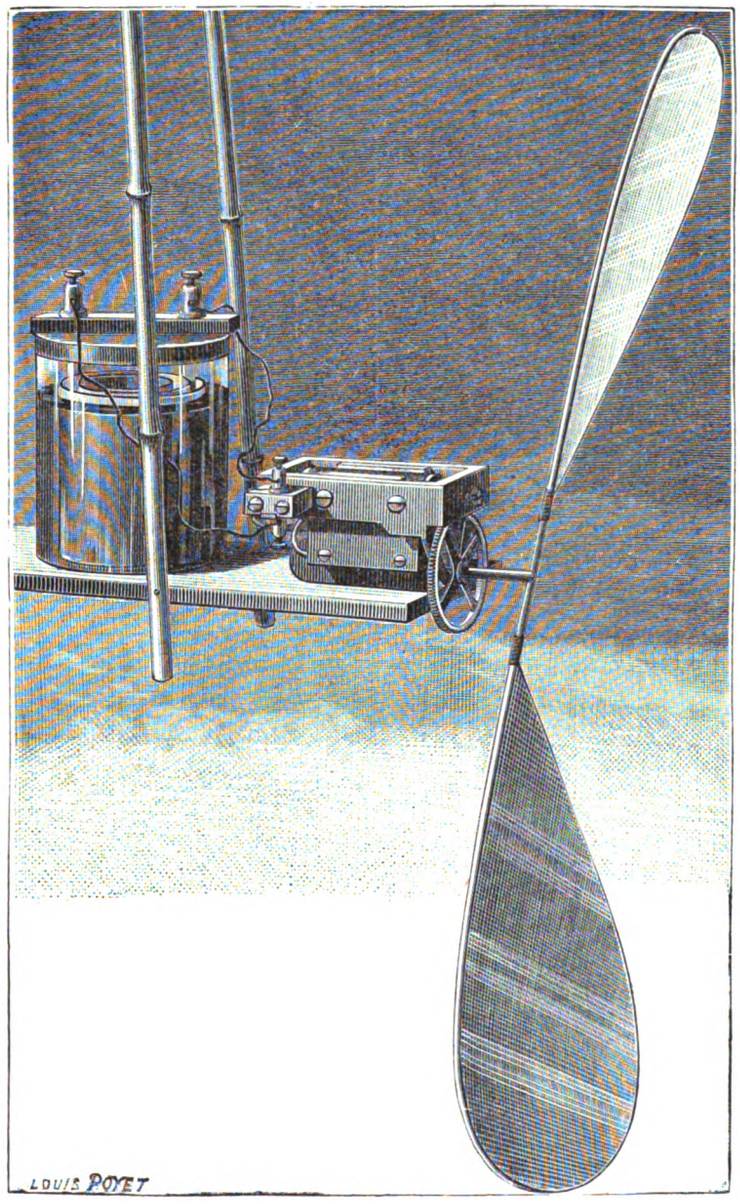

FIG. 2.—THE MOTOR OF GASTON TISSANDIER'S SMALL ELECTRIC AËROSTAT (ONE-HALF ACTUAL SIZE): TROUVÉ DYNAMO-ELECTRIC MACHINE, WITH PROPELLING SCREW AFT OF THE BOAT: PLANTÉ SECONDARY BATTERY.

THERE is said to be a good prospect of another gas war in Brooklyn. Some time ago, when the inhabitants were being driven to use kerosene by the exorbitant charges of the old corporations, the Fulton Municipal Company was started in opposition. But as soon as they had laid their pipes and entered into actual competition, the older companies bought them up by a payment, it was said, of $112,000. The term of the agreement is now about expiring, and it is reported that the Standard Oil Company will take charge of the Fulton Municipal Company, and oppose the old corporations in full earnest.

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ELECTRICITY AND TEXTILE MANUFACTURES.

THE dominating position that electricity is going to assume, its ever-varying possibilities that become almost kaleidoscopic to even scientific men, are almost ignored by the general public. Electricity, in the mind of the ordinary citizen, has become inextricably confounded with gas; but the great fact that electricity is *not* gas, that it is force as well, and that it contains in its future immeasurable possibilities, if for no other reason than that its mysteries have not yet been profounded, is a fact not sufficiently-appreciated.

Electricity is not merely light, in the physical sense of the term, it is nature's own force; it contains within it the chemical force agents that produce those incessant and ever wonderful changes by which poisons become elixirs and the balmy air turns to fetid exhalations, to disease and death.

But, as a force, electricity can be utilized, and this to an extent that the wisest of us cannot dream of. How suddenly has come our awakening? The telegraph has been in operation for a generation, and yet the manifold other uses of electricity are now only being estimated and made use of.

The application of the electric force to textile manufacture is of great importance, for its peculiar *rôle* is to give notice of defects; and thus it has an important bearing on the regularity and uniform quality of the manufacture. There is yet much to be done in this line, however. Partial success has been obtained in applying it to weaving looms, but it cannot be considered as yet practically available.

A machine for weighing spool or other thread has just been invented by M. Mouchère of Angoulême, France, which fulfils exactly the required conditions, and it can be used for weighing all matters that are delivered in a continuous manner and that require to be weighed repeatedly and with great exactness.

Threads and twists are numbered, but this implies that there is a certain proportion between the weight and length of the thread. The counters hitherto in use were only approximately correct.

The apparatus of Mouchère consists of two distinct parts, one obeying the other. The first consists of a pair of scales with brays—one of these latter is for the weights and the other as a receiver for the wound thread. The second part is composed of a train arrangement for the thread, that is determined or stopped by the action of the balance, so as to stop the reeling or allow it to go on. When the necessary quantity of thread has been furnished by the reelman, and the thread put in the receiver on the balance, the latter, when it is thus put in a state of equilibrium, stops the reeling in the following manner. The tray bearing the weight sustains also a balance verge having two pins, which are plunged into or withdrawn from two cups filled with mercury by means of the oscillatory movement. One of the cups is put in communication by means of a wire with one of the poles of a pile, the other with an electro-magnet which closes on the current of the same pile.

The function of this electro-magnet is to attract a piece of soft iron placed at the end of a lever, the other end of which acts on a pressure or top cylinder underneath which the thread passes, so as to put it on a pulley that is always running. It is this pulley which carries the thread along, but only when brought into forced contact by the cylinder; and this does not take place unless the electro-magnet attracts the lever. As soon as the action of the electro-magnet stops, the train stops also and the reeler.

The action of the electro-magnet is only while the current passes—that is, only when the needles are immersed in the mercury. Of course the part supporting the needles is isolated from the verge connecting it with the scales; the latter are altogether out of the magnetic current, which has no effect on them.

The annexed drawings will give a sufficiently clear idea of the principle and working of the apparatus.

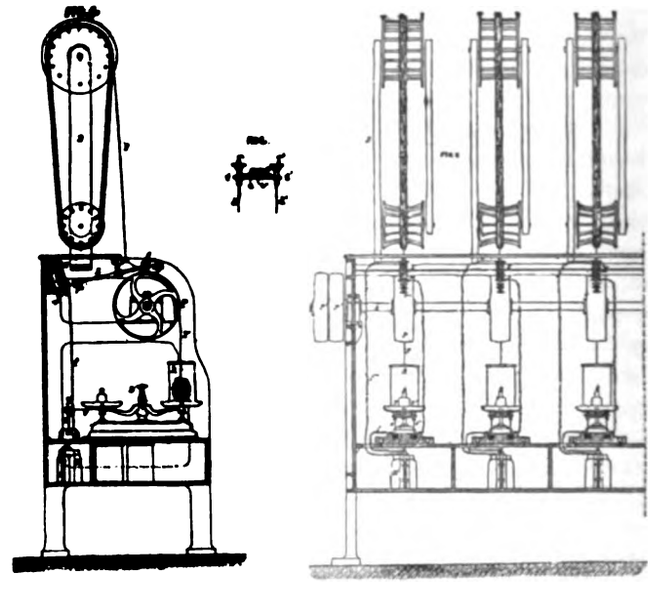

Fig. 1 is a cross section of the reeling apparatus.

Fig. 2 is a longitudinal section running from back to to front.

Fig 3 shows the arrangement of the needles in detail.

The reelers D are mounted on a frame of suitable form; the thread F running off passes under the pressure roller *g*, which at a given moment presses it against the train pulley P, which rolls it in the receiver R; this pulley, which is fixed on the power shaft A, is constantly turning. The general motive power comes from two driving pulleys P′ P′.

The various scales B are on the frame at a suitable height, and the weight trays have a verge V, bearing needles *a a′* and surrounded with isolators *c*. These needles are drawn tightly between cross pieces *t* and strap bolts *e* (Fig. 2). By means of regulating bolts T T′ the height of the points *a a′* can be fixed, and the electric transmission is obtained by means of small mercury baths *b b′*.

The friction or pressure roller *g* set in two vertical grooves, is subjected to the action of a lever L, the oscillation point of which is in O′. It has at its other end a contact in soft iron, the position of which is regulated by the screw *v*. An electro-magnet E is placed perpendicularly before this contact. A movable counterweight P″, the position of which may be changed at will, is used to balance the lever P and diminish the effect of attraction. A screw *v*, fixed on the frame, limits the amplitude of the lever so as to keep it within the attraction of the electro-magnet E.

The electric piles H are placed below the scales, and may be of any system. The circuit is composed of the wires *f f′ f″*, of the mercury baths *b b′*, of the needles *a a*, and of the cross piece *t*. The current remains closed during the passage of the necessary quantity of thread to make the scales balance, and at the precise moment this occurs, the current is interrupted and the machine stops.

This system not only allows a great degree of exactness to be obtained, but also enables a single work-girl to oversee several reelers at the same time.

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RECORDING TELEGRAPHS AND SOUNDER TELEGRAPHS.

IN an article entitled "Writing Telegraphs and Speaking Telegraphs," Mr. Frank Geraldy compares the telegraphic instruments used in France and in the United States respectively, having regard principally to the question of economy of time. In France says he, in *La Lumière Électrique*, we use "writing" (recording) instruments only: in America they use only "speaking" (sounding) instruments.

The simplicity of this latter system, he goes on to say, is certainly very much in its favor. And when we consider the well-known tendency of the French telegraph companies toward excessive minuteness of control and overmuch scribbling, we incline to believe that the adoption of writing telegraph instruments here (*i. e.*, in France) is mainly due to considerations of that kind. Still it may be questioned whether from the point of view of control the writing instrument is better than the other. In fact, under the American system, the original message is filed at the office from which it is dispatched; the telegram received bears the signature of the agent sending, as also that of the agent receiving it; if there is any error, it can always be corrected, and it can always be found who committed it. It is true that this may not be so easy as with the French system, where the printed ribbon from the instrument may sometimes supply the correction directly. In France it is not considered of much consequence to know who transmits the message, and often it would be difficult to decide where to lay the blame of a serious error.

On the whole, looking at the matter in a general way, the system of speaking instruments appears to present the advantages of being simpler and cheaper; further, if we are to believe certain assertions that have been made, it insures greater rapidity of transmission—an advantage of the highest importance, which of itself would establish the superiority of the system were it demonstrated to exist.

But we must examine this point more closely. There is no *a priori* reason why the writing instrument should be less rapid than the other. The employee is in nowise retarded in his work by the presence of the ribbon that is rolled off before him; on the contrary, his task is facilitated, for it is easier to write from written or printed letters than from sounds. As for the instrument itself, there is no reason why its action should be slower. True, it is a little more complex, but not sufficiently so to diminish the steadiness of its action. Besides—and this will perhaps surprise many—writing instruments require less force than speaking instruments. In the latter, the shock must be strong, in order that its sound may be clear and distinct, and this necessitates stronger currents.

Even the simplicity of the talking instrument and its greater cheapness are not unanswerable arguments in its favor. In the first place, those are points only of secondary importance. Secondly, this advantage has its counterbalance in the fact that, if the instrument cost less, the operator costs more. This is plain, for it is much easier to learn to read an alphabet than to accustom the ear to appreciate the values of sound-signals consisting of clicks, with greater or less intervals between. Hence it is that operators fitted for this difficult service are fewer, and command higher pay than the others.

These considerations notwithstanding, the example of the United States is of very great weight: the practical character of the Americans gives a strong presumption in favor of the system universally adopted among them. Nevertheless we find in the report of Mr. Brooks for the year 1873, an explanation of these facts, which gives them a totally different aspect. According to him it was owing to the imperfections of the early Morse instruments that recourse was of necessity had to the talking instrument: hence this was not a case of selection determined by the advantages recognized, but simply a result of necessity. The explanation is certainly a curious one, and may have a measure of truth: still it must be said that the Morse apparatus was improved long ago, obviating the original objections, but yet the Americans have not gone back to it, preferring speaking instruments.

In short, the question is one that cannot be settled offhand—it has its *pros* and its *contras*. It is quite probable that upon this point, as upon many others, no absolute solution is attainable. It may be said that under certain particular circumstances a particular system will be employed. Thus on railway lines, where the responsibility is so great, there is clearly an advantage in the use of writing instruments. On the contrary, in war, in traveling, in case of temporary installations, the speaking apparatus alone is imperative.

As for the rapidity of action attributed to the American service, it may be that such may be the fact, but it would still remain to find out whether it is attributable to the instrument or to the operator. In the United States telegraph operators are men of special capacity; they work like men that are well paid, of whom much is required, and who are liable to discharge if they do not give satisfaction. In France telegraphers are government officers: they work after the manner of indifferently paid public officers—methodically, quietly, never forgetting that they form a part of the government, and that they possess those famous *acquired rights* (*droits acquis*) which are the chief reliance of government functionaries in France.

But at all events our operators should know how to use the speaking instrument. Such knowledge I know is required of them, but I doubt if they are very familiar with that mode of transmission. In the examination to which employees of the Military Service telegraph are subjected, they have to read by sound: but in not a few instances the examiner has been obliged to reduce this test to its simplest terms, lest he should have to reject employees otherwise capable.

—— A TELEGRAPH SYSTEM has been established between Liverpool and Manchester on the same principle that is now confined to single cities.

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THE ELECTRICIAN.

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ELECTRICAL TRAINING.

A DEMAND which becomes widespread, powerful and imperative in its exactions, is the result of natural forces working toward the same centre; to create such a demand by deliberate forethought is beyond the power of individuality. A demand once established will be satisfied in the due course of events, whether it be in art, science or manufacture. There is now a rapidly growing want for men trained in the theory and practice of the science of electricity. That this science will be of the utmost importance during the coming years, both in its scientific and practical aspects, we firmly believe; the brilliant names now making it a life study; the achievements, so rapid as to be almost beyond the power of a single mind to keep track of; the practical uses to which it is now applied and the boundless scope to which it will be applied in the near future: these characteristics, all tending toward the utilization of a force in nature, have already created a demand for men, not only well versed in the theory of the action of the current, but who thoroughly understand the mechanical construction of the various appliances necessary to produce and control this current. The demand is established, and it now behooves our foremost educators to devise a means of satisfying it.

Education should so qualify a man that he can discriminate between the wheat and the chaff in the works of others, and, assimilating the good, add to it according to the measure of his own ability. He should be able to turn to practical use his acquired and inherent knowledge, and he should also—this is but seldom the case—be able to impart it understandingly to others. His course of study should so qualify him that he can and will think for himself, not following in the beaten path of others, and that he will have recourse to his own brain in times of difficulty rather than depend on the efforts of others. In short, he should search for truth in nature and according to nature's laws.

The student of a profession should have the advantages to be derived from the best teachers—not necessarily the most learned—and, as aids, should be surrounded with all the requisite apparatus constructed according to the latest developments in his line.

There are vacancies now awaiting thorough electricians, and our institutions of learning will be looked to to fill these vacancies. Whether the course should be special during a portion of the regular course, or post-graduate, are questions to be decided by others—there are strong arguments in favor of each. One thing is certain; the college which undertakes this will, to succeed, have to obtain all the electrical appliances now in daily use. The medical student in the dissecting-room and hospitals is made conversant with his future work; the student in chemistry obtains practice in the laboratory; the student in mechanical engineering now obtains, in our best technical schools, a practical insight into the laws which govern the movements he utilizes; students from these enter at once upon the duties of their professions. Students in civil and mining engineering graduate with an intimate acquaintance with the theories of their professions, but only after an apprenticeship varying in duration according to circumstances and individual ability do they become capable of assuming responsible positions. A comparison of the relative advantages is not essential at present. The demand is impatient, and there is no opportunity for a supplementary course under a thorough electrician. The chrysalis must come forth perfect as far as his intellectual capacity will permit, and the education must be of such a character as will admit of this.

If electricity have one-half the scope we think it will, it is destined to occupy the highest rank, and consequently demands consideration from our institutions. In it there are fields of thought which have only been entered upon but not explored; and, reasoning of the future by the recent past, there is a work to be accomplished by investigators in electricity who will make straight paths which are now crooked.

A CONTINUATION of Mr. HOSPITALIER'S article on "The Storage of Electricity" will appear in the next number of this paper.

IT is a gratification to refer our readers to the very interesting contribution of M. GASTON TISSANDIER, the noted scientist of France, and editor of that charming paper, *La Nature* of Paris. It is to be hoped that the pioneer and ingenious apparatus of M. Tissandier may prove successful, and that electricity may solve the problem of aerial navigation.

WE would express our acknowledgments to *The Telegraphic Journal and Electrical Review* of London for many courtesies, also for copy of the report of "The Telephone Case" recently decided in Edinburgh. We are requested to state that those interested in the above case can obtain full copies of the report at D. Van Nostrand's, 23 Murray street, New York.

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THE TELEPHONE—ITS CONSTRUCTION AND USE.

PART II.

IN continuation of the above subject we recently visited the offices of the Law Telegraph Company of this city. This company operates Exchange Systems in New York and Brooklyn, and its central offices are connected by trunk or connecting wires with those of the Metropolitan Telephone and Telegraph Company, thus enabling the subscribers of the two companies to intercommunicate. The instruments used by the Law Telegraph Company are the same as those used by the Metropolitan Company, that is, the Blake Transmitter and Bell Receiver, of each of which we gave a description in our last number.

Nearly all the rest of the apparatus, however, as well as the *modus operandi*, is radically different, and merits a full description.

In addition to the usual wire (the individual wire) connecting the subscriber with the central office, he is provided, in common with about 130 other subscribers, with a circuit wire, styled the "calling wire," which is used exclusively in giving the orders to the central office for connecting and disconnecting the individual wires. The use of this calling wire enables the company to do away with annunciator cases, switch boards, local and trunk tables, jacks, etc., in the central offices, and to substitute therefor, as the sole apparatus of the office, a table thirty-four inches square, on which are concentrated no fewer than 400 individual wires, 75 to 100 trunk wires and 4 calling wires. Around this table are seated four operators, each of whom has a transmitter and a receiver in the circuit of a separate calling wire. The transmitter is placed on an upright rod at his right, and the receiver is held constantly at his ear by means of a steel band passed over the head, which band serves also as the magnet of the telephone. He is therefore always in readiness to receive an order without the necessity of a preliminary call or signal, and both his hands are left free to fill the orders. Each of three of these calling wires connects with the premises of about 133 subscribers, and the fourth connects with all the other tables in the system, whether located in the same or in other central offices. The former are styled subscribers' calling wires, and the latter "trunk line calling wires," because used for transmitting orders to connect and disconnect the trunk lines. All tables in the system are exactly alike in every respect, and each has a certain number of trunk lines in direct connection with every other.

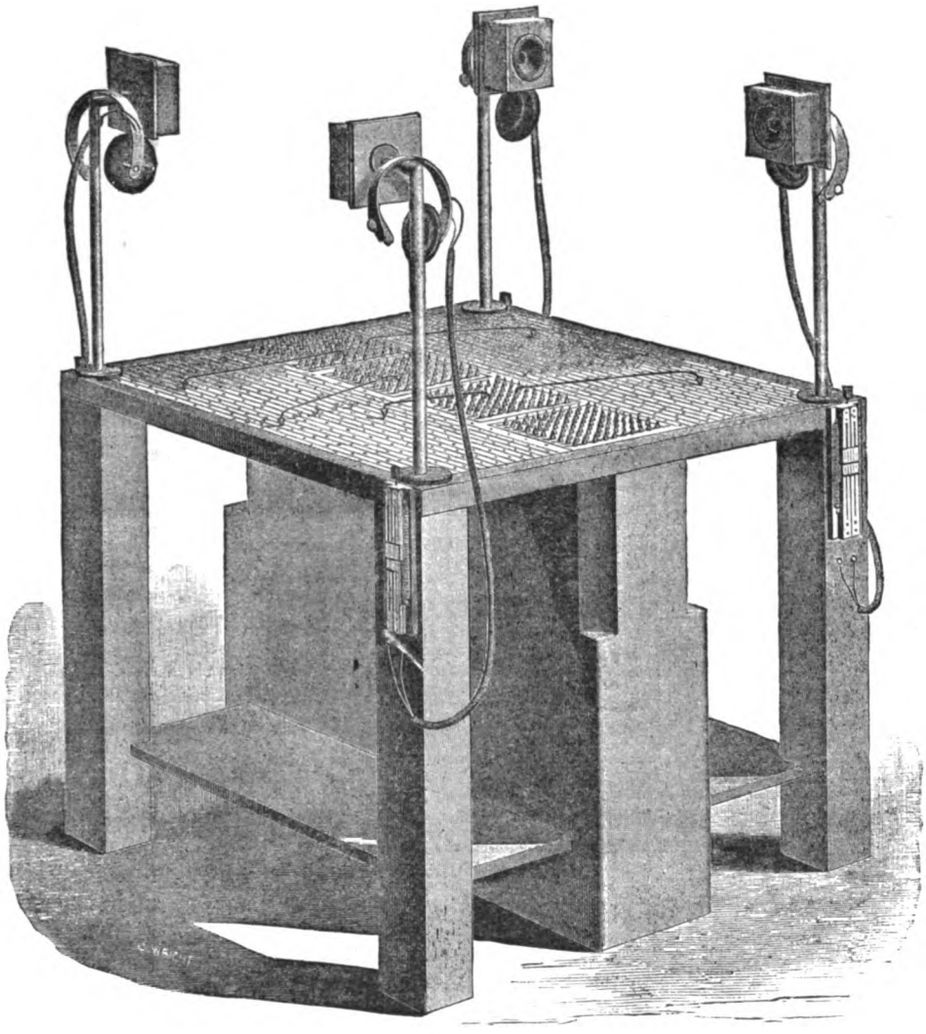

FIG. 1.

Figure 1 is a cut of the table; its construction is as follows: Each individual wire enters the box in the centre, from the floor below it, and connects with a vertical brass tube about two feet in height and half an inch in diameter. A brass rod about a foot long and carrying a little flat spring is suspended in each tube (see Fig. 2) by a stout flexible cord which terminates in a brass cap bearing a steel pin and resting on a ground plate set just above the tubes, but separated from them.

The rod is made to move freely through the tube, and the spring maintains an electrical connection between them, which is never broken.

This box of tubes opens in the centre of the table top, all parts of which can be easily reached from any side, and of which the ground plate forms a portion of the surface, the rest being composed of 75 to 100 square brass bars drilled with holes to receive the steel pins. A por-

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tion of these bars are connected with trunk wires leading to similar bars on similar tables (either in the same office or other offices), and the rest are used for local connections.

The tubes are arranged in four sections of 100 each, each section ten tubes square, and numbered from 0 to 9

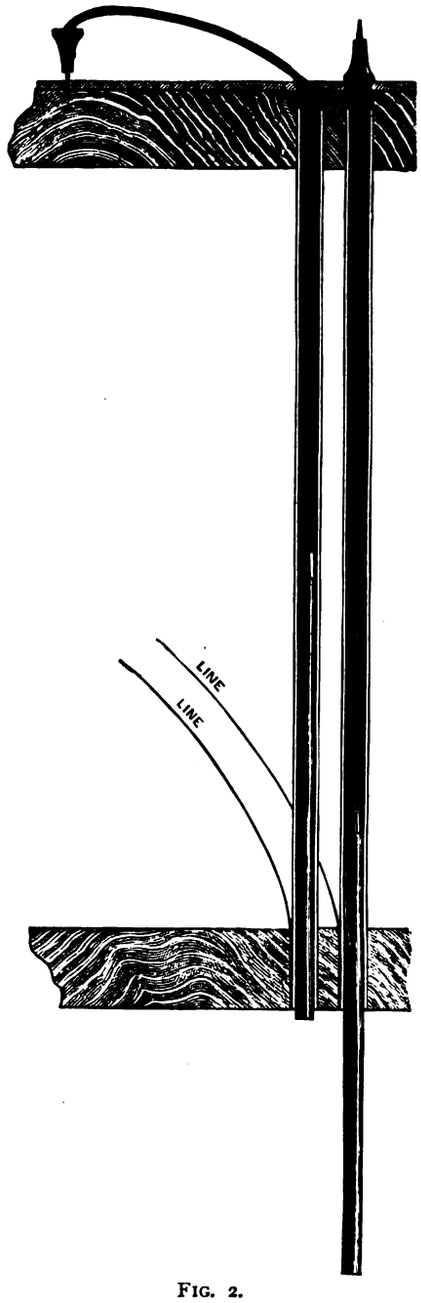

FIG. 2.

on all four sides, so that the figures can be read equally well from all sides of the table.

The figures on either of the two parallel sides may stand for tens, and those on the other two sides will stand for the units—the hundreds are understood.

It must be readily seen that with this system of numbering the operator can select any plug more quickly and surely than if each plug bore its own number. The plate bearing the figures is connected with a battery having a pole-changer or circuit breaker in its wire—or with a generator if preferred—so that when a plug is touched to it the subscribers' bell is given a continuous ring. A small key is inserted in each square bar, which, when depressed by the finger, bears against a plate underneath similarly connected. When subscribers have been connected they can be rung up by these keys without disconnecting.

Another plate, that next to the one numbered, is connected with the same battery, but directly, and used for giving single strokes.

The push-button switch shown underneath each transmitter is used to switch the telephones temporarily into

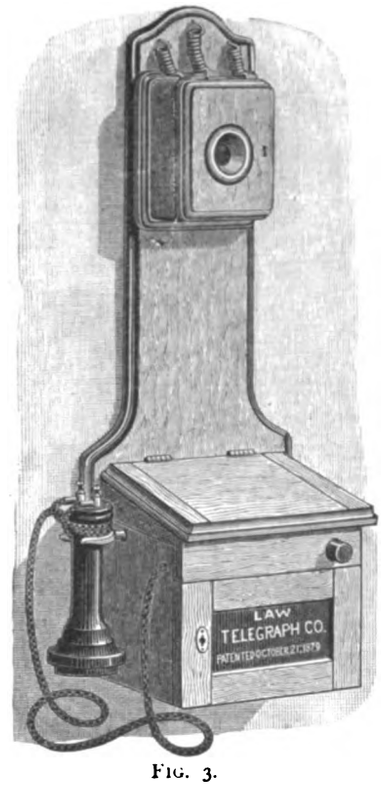

FIG. 3.

a trunk calling wire coming from another table. When there is more than one such wire, there is a switch for each.

The subscribers' outfit is shown in Fig. 3. The usual magneto generator is dispensed with. The black knob seen projecting through the door is the same switch shown at the corners of the table, and when held pressed in, it connects the entire apparatus with the calling wire: in its normal condition the apparatus is in the circuit of the individual wire. The box contains, besides this switch and the gravity switch (holding the receiver and used for automatically switching from the call bell to the telephone), one cell of "Law" battery and a simple call bell.

Figure 4 shows the combination of the circuits, and will serve to illustrate the operation of the system, which is as follows: Subscriber 113 wishing to communicate with subscriber 394, he switches into his call wire (C^1) by holding his finger on his push-button and calls "113–394."

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Operator S^1 immediately selects these pins, one with each hand, holds them an instant on the continuous ring-up plate, inserts them in a bar and the work is finished. Whole time occupied about three seconds. The conversation ended, 113 calls, "113 off," and the operator S^1 immediately withdraws pins 113 and 394, one with each hand, touches them to the single stroke-plate, thereby giving a disconnect signal to each subscriber, releases them, and they run back to their places. Whole time occupied, about two seconds.

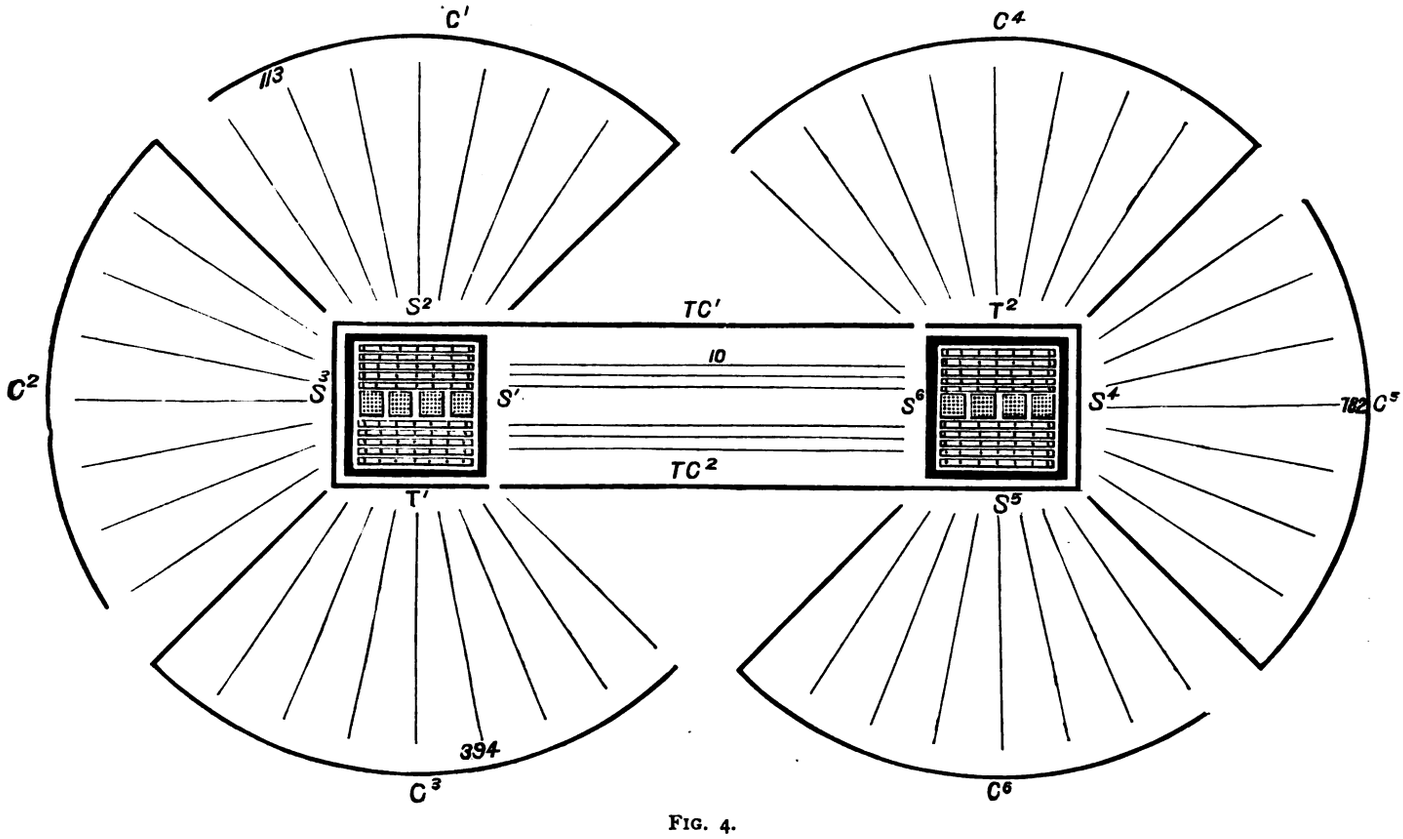

FIG. 4.

If the call had been "113–782," 782 being a subscriber connected with another table (either in the same or another central office) the operator S^1 would then have selected a trunk line bar leading to that table, say bar connecting with trunk line 10, with one hand rung and connected 113 with that bar and with the other hand pressed his push button switch and called over wire T C^1 to the distant operator 782–10 and T^2 would immediately ring and connect 782 with the bar similarly numbered in his table. Whole time occupied about five seconds.

The disconnection is similarly accomplished. It will be observed that the operators at the same table work entirely independent of each other, and they never speak, except over a trunk call wire, to a distant operator.

Should subscriber "782" give the order to disconnect, it would be received by operator S^5, who would withdraw pin "782," switch into wire T C^2, say to operator T^1 "10 off," whereupon operator T^1 would withdraw pin 113 from bar 10. All subscribers are numbered and names are not used at all.

Subscribers do not interrupt or interfere with one another on the calling wire, because they distinctly hear each other, and each order is but a word or two and is filled at once.

Under this system a subscriber can connect and disconnect at will with other subscribers in rapid succession; an invaluable feature for giving quotations to customers, ascertaining the whereabouts of a party, and for many other purposes.

Some of the calling wires are "metallic circuits" and some of them "ground circuits." Usually they "loop" into the subscriber's office, although they sometimes merely "branch" or "tap" in.

PROF. BERNSTEIN, of Boston, recently devoted himself to convincing the visiting underwriters that most of the tales regarding the danger of electric light wires are unfounded. In order to show that no danger of fire attends the introduction of the incandescent light into dwellings, he shattered a globe of one with a hammer, when the light at once went out. When the company was arrayed about one of the large lamps burning in the basement of the Mechanics' Building the professor astonished some at least of the party by breaking the wire close to the lamp with a pair of nippers. The only result was the instant extinguishment of the light. "You see I am still alive," he said; and then, taking up the broken wire, one end in each hand, he united it, and the light immediately resumed shining. These tests, several of the gentlemen said, demonstrated perfectly what Prof. Bernstein said—that when electric light wires are perfectly insulated by thick coatings and are carefully strung, there is no danger to life or property if they are cut by an axe or if they fall across a telegraph or a telephone wire, or even if a man takes hold of them to make connection with a lamp.

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ON THE APPLICATION OF ELECTRO-PUNCTURE TO THE TREATMENT OF PULSATILE EXOPHTHALMOS OF THE ORBIT.

DR. GEORGE MARTIN of Bordeaux has recently published a note on a case of pulsatile exophthalmos of the orbit cured by electro-puncture. Believing this to be the first instance in which the subduction of an orbital aneurism has been effected by the agency of the voltaic current it seems to us of sufficient interest to be described at some length.

The injury occurred to the left eye of the patient who was the subject of the observation, and developed as a result of a serious fall that produced primarily a fracture of the base of the skull. Various troubles affected the parts of the eye on one side of the sight, and gradually increased. Two months after the fall Dr. Martin diagnozed a pulsatile exophthalmos. It is not within the province of this article to discuss the reasons which led him to modify his diagnosis and describe it as an arterio-venous aneurism after having believed it an arterial aneurism only: the reason being fully detailed in a memoir that the author has published in the *Journal de Médecine de Bordeaux*. But we must directly describe the means employed to effect the cure.

The method adopted by Dr. Martin is that which was suggested by Ciniselli, and which consists in introducing in the aneurismal sac pointed wires or needles, which serve as the electrodes of a voltaic battery, but with the precaution of first adjusting the needles connected with the anode of the battery, before opposing to each of them the negative electrode.

The blood immediately coagulates around the needles, apparently under the influence of the positive electricity, and the existence of a nucleus of solidified blood appears to favor the production of clot under the influence of the negative pole. A consequence of some little practical advantage is, that the needles soon firmly implant themselves in the tissue and do not require to be supported.

The note that we are discussing is especially interesting because, contrary to the usual custom, the author has clearly stated the electrical conditions employed. Not that he in effect measured the current during its action, but he conveys sufficient information regarding it to enable a competent person to reproduce practically the same conditions in an analogous case. We quote the passage relating to this determination: "The cells we employed were those of the Leclanché chloride of ammonium battery. By means of a collector we could include in the circuit as many or as few cells as we desired. A commutator permitted us to reverse the direction of the current without sending through the wires the *induction* shock ('sans choc voltaique'), which is very important when operating near the optic nerve in which any sudden electric impulse gives rise to luminous sensations extremely disagreeable, and even in certain cases dangerous."

Before each séance we measured by means of a voltameter the force of the battery that we intended to employ. We determined how many cells were required to yield 25 millimetres of gas in five minutes by the decomposition of water acidulated with $\frac{1}{10}$ of its weight of commercial sulphuric acid.* The number of cells thus indicated has never been exceeded in any of our operations. Often, however, in consequence of the insupportable pain attendant upon the employment of such a current we were obliged to reduce the intensity by diminishing the number of cells. As Dr. Martin has admitted, it would have been better to have measured the intensity of the current at each instant during the operation; but the *data* given are sufficient, except one obscure point regarding the commutator, and should be approved.

The needles employed, three in number, were made of platinum and were plunged in the interior of the tissues in such a manner as to be separated by intervals of one centimetre. The patient was submitted to treatment on six separate occasions between Oct. 15, 1880, and January 25, 1881. During the first of these occasions the number of Leclanché elements employed was not less than six, and at the maximum was increased to eight; on the last occasions the number of ten cells was attained. On the various occasions, the actual time during which the patient was submitted to treatment was successively 26, 36, 24, 89, 85, and 53 minutes. Furthermore the current was not allowed to flow continuously in the same way during the whole séance, but the manner of applying it was changed occasionally, whereby the séance was divided in distinct intervals, as will be indicated by the following tabular exhibit of the first operation.

First period, 3 minutes. 1 needle at the + pole. The — pole connected with a conducting plate applied to the forehead.

Second period, 6 minutes. The 1st needle at the — pole. A second at the + pole.

Third period, 5 minutes. The 2d needle is put at the — pole; a 3d at the + pole.

Fourth period, 4 minutes. The 3d needle at the — pole. The 1st at the + pole.

Fifth period, 4 minutes. The 1st needle at the — pole. The second at the + pole.

Sixth period, 4 minutes. The 2d needle at the — pole. The 3d at the + pole.

The succeeding operations were similarly conducted.

On the 25th of January, the date of the last operation, the tumor that had been treated had completely disappeared; but indications of a second were manifested in a new place; it was immediately attacked in a similar manner and but once subjected to treatment, for by the tenth of February it was announced that no sign of the aneurism remained.

Four months later than January 25th, the cure was perfectly maintained, and all the symptoms which had accompanied the tumor had disappeared.

A consideration of Dr. Martin's statement leaves little doubt that the result obtained was actually due to the action of the voltaic current, and was not due to a spontaneous cure. At each treatment, and immediately, an amelioration of the symptoms was evident. After the fifth and sixth occasions the effects were more perceptible and the action was complete; all the souffle and the pulsation had disappeared in the principal tumor when the needles were withdrawn on the fifth occasion, and from the swelling which was later observed on the sixth occasion of treatment.

In point of fact the complete cure was effected in five operations, and by a total duration of the action of the current not exceeding three hours and fifty minutes; for as a matter of fact the time of the first séance should not be included, as the current by reason of a mistake was passed in a direction the reverse of that desired.

As an unforeseen accident, and not of great importance, we must mention the production of an eschar seven millimetres in diameter at the time of the fifth operation; after which, as in all other cases, only a little brownish ring surrounding the needles remained.

This observation shows that excellent results may be derived from the use of electricity in cases analogous to

* Since the article translated does not specify cubic millimetres, and the diameter of the gas-measuring tube is not given, which would be required if linear millimetres were meant, and since the form of voltameter is not designated, the measure is indefinite. Probably cubic millimetres of the mixed gases are meant. —*Trans.*

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that described, even though they arise from venous dilatations only. Dr. G. Martin thinks that the electrolytically produced dots retained against the sides of the veins are not liable to move, and that there need be no fear of embolic accidents. We do not know whether all physicians will adopt the view of the matter we have here discussed; but the fact is in itself of interest, the data are sufficently complete as far as the application of the current is concerned, and the work of Dr. Martin is worthy the attention of the readers of *l'Électricien.*

C. M. GARIEL.

IMPRESSIONS PRODUCED UPON ANIMALS BY THE HUMMING OF TELEGRAPH WIRES.

THE black woodpecker, and also the green (*picus martius* and *picus viridis*), live upon the insects which they find under the bark and at the heart of decayed trees. In the vicinity of the pine woods in Norway, wooden telegraph poles, although newly impregnated with sulphate of copper, are found entirely pierced sometimes by the birds. The humming produced by the vibrations of the wire leads the bird to think that the interior of the pole is full of worms and insects, and therefore he pecks at it. His bitter disappointment can be conceived when, after having perforated the pole from side to side, he finds nothing. The holes thus made are usually found near the insulators, and are sometimes as much as three inches in diameter.

The bear is also a victim of this acoustic illusion. He is very fond of honey, and when, in his solitary wanderings, he hears the vibrating wires, he mistakes the noise for the humming of a swarm of bees. He follows the deceitful lead up to the pole where the sound seems loudest, and, since he does not find the wished-for hive, he thinks it hidden under the pile of stones which support the pole; he then scatters these stones in all directions; finally, deceived in his hopes, he gives the pole a powerful blow with his paw, so as to have the satisfaction of at least thoroughly frightening all the bees, which he now supposes to be hidden inside the pole. These scattered stones could not be accounted for until the discovery of the marks made by the claws of the angry bear.

Telegraph wires have also an influence upon wolves, but it is not so sharply marked as in the case of bears and woodpeckers. When the necessary funds were to be appropriated to build the first lines in Norway, a member of the Storthing declared that although that part of the country which he represented was not directly interested in the project, he should vote in favor of it because, in his opinion, the wires so stretched would drive away the wolves from the whole district traversed by the line. It had already been noticed that wolves, no matter how hungry they were, would not encroach upon places around which cords had been stretched from post to post. In fact, when the line was built—more than twenty years ago—the wolves disappeared and have not yet returned.

It might be objected that this disappearance of the wolves could be attributed either to their wandering away, or to the ravages of disease; but it is certain that the fact has no precedent in a country which is well suited to their habits.—*L'Electricien.*

—— A BERLIN CORRESPONDENT to one of the London papers says: "The postal authorities are now buying an improved telephone, which the patentee declares to be able to transmit vocal sounds from Hamburg to Berlin."

OUR PARIS CORRESPONDENCE.

PARIS, February 17, 1882.

SINCE the International Exposition of Electricity held in the Palais d'Industrie, electrical science and its manifold applications seem, as it were, to be taking a moment's rest preparatory to bringing forth fresh wonders and making another advance step.

In the matter of electric lighting, in default of new inventions of any great importance, the war between gas and electricity continues. As a matter of course, it is in the very heart of Paris that the most activity is shown, and there, too, all experiments of any moment are made. The Avenue de l'Opéra, with its neighborhood, is the principal scene of this rivalry. In a walk of ten minutes an attentive observer will notice a good half-dozen different systems. Between the Opera House and the Institute we observe:

1. The Siemens differential lamps, used in a large music store.
2. The Jabloshkoff candles, used to illuminate the Place de l'Opéra and its dependencies.
3. The Maxim lamps, which light up the offices of the Compagnie Générale, No. 12 Ave. de l'Opéra, and which are to be seen also in one of the side streets, the Rue d'Argenteuil; these lamps are fed from electric accumulators, to which we shall soon have occasion to recur.
4. Lamps of the Mersanne system, used in the Place du Carrousel.
5. The Brush system in the court of the Louvre.

No doubt two or three other systems might be found were one to search more closely for them.

The gas companies, not to be behindhand, have just set up four new Siemens burners in the Place du Palais Royal; but it is yet too early for us to formulate an opinion or to venture on a comparison.

Aside from electric lighting, there are two questions which still largely occupy the mind of "Paris-électrique," namely, the transmission of forces by electricity, and the distribution of electricity to houses. Two companies have lately been formed to experiment upon and develop these two branches of electrical activity. One of these companies has a capital of 10,000,000 francs—some two million dollars—and its director is Mr. H. Fontaine, a gentleman well known for his energy and intelligence. It is yet too early to attempt to forecast the future that awaits this enterprise, but in my opinion it has a very fair prospect of success. The other company, which came before the public making a far greater outward show is, I fear, at least in a position of embarrassment. The recent collapse of the Union Générale, which had undertaken the organization of this company, has sadly compromised it, and the 75,000,000 francs that were to constitute its capital are yet to be gathered in.

On January 28th a grand ball was given at the Palace of the Ministère de la Guerre (War office), by the alumni of the Polytechnic School, for the benefit of their Aid Fund. In the dancing hall the Werdermann, Jabloshkoff, Maxim and Jasper systems gave practical demonstration of the excellence of the electric light; still the greatest success of all was unquestionably achieved by the incandescence lamps, whose mild light did full justice to the red tints and the bronzes of the grand ball-room.

Electricity will also play an important part in a grand evening party to be given by Admiral Mouchez in the magnificent *salons* of the Observatory on the eleventh of March.

Mr. Gaston Tissandier will on that occasion deliver a lecture on the applications of electricity to domestic uses—an interesting subject and a timely.

YOUR PARIS CORRESPONDENT.

—— THE ELECTRIC RAILWAY COMPANY has been incorporated in London for the purpose of constructing electric railways in various cities of Great Britain.

—— IN A PAPER READ by Principal Jameson, of the College of Science and Arts, before the Institution of Engineers and Shipbuilders, Glasgow, Scotland, the lecturer stated that 1,400 or 1,500 lamps for electric lighting had been fitted up in war and first-class passenger steamers. Judging from the rapidity with which they were supplanting the old oil lamps, it might be expected that ere long nothing else would be used for the lighting of ships.

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OUR LONDON CORRESPONDENCE.

LONDON, March 2, 1882.

THE INTERNATIONAL ELECTRIC EXHIBITION AT THE CRYSTAL PALACE.

IT would be quite out of place to dwell here on the success of the International Electric Exhibition held in Paris from the beginning of August to the end of November, 1881, this subject having, since the said exhibition began to show any signs of completeness, been dealt with *ad nauseam* by the scientific and general press of the whole world.

It was only natural that the happy idea would strike an ingenious mind that as all the exhibits assembled together on the occasion of that great solemnity had been consigned there at great trouble and expense, very little inducement would be required to persuade at least a great proportion of the exhibitors to extend the exhibition period and transfer their goods to some other quarter. And this is how London is now enjoying a certainly very interesting sight, in what is somewhat pompously and certainly erroneously called the Crystal Palace International Electric Exhibition. That such a plan suited the American exhibitors who had to return their goods through England, English exhibitors who had to bring their exhibits back at home, and a very few of the enterprising nearest English neighbors, such as French and Belgian, there is no doubt; and it can readily be conceived, and it was to be expected that the English companies as well as the American and a few other foreign ones established in England, would seize on the occasion of making, at home or at their adopted home, what they could not have thought of doing in foreign countries, where they had to contend with all the difficulties attending ignorance of the language as well as of its customs and habits.

The display of lighting is certainly a grand one, and the nature of the palace, together with it contents, lend themselves very well to an effect which could not easily be obtained elsewhere. The majority of systems of electric lighting are exhibited there, separate and distinct portions of the building having been allotted to the various companies, or individuals respectively working them, and a few of which have carried out the idea, one might say almost regardless of expense; so that it may be said that if those exhibits are intended to show what results can be obtained with the electric light, they certainly also illustrate what can be done with money and profusion.

The Brush light is fully represented there, in two distinct exhibits: that of the Anglo-American Brush Electric Light Corporation, and that of the Hammond Electric Light and Power Supply Company, limited, a company very recently formed for the purpose of working, under license from the Anglo-American Brush Light Company, the Brush system (as well as the Lane-Fox incandescent system, of which the Anglo-American Brush Company have acquired the right) in certain counties of the north of England.

The Brush Company are lighting the tropical room, or north end portion of the palace, together with some side rooms; and they make in these various parts a fine display of the Brush arc and Lane-Fox incandescent lights. Their engine-room has been fitted up in a style similar to that which they had adopted at the Paris Exhibition, and which leaves nothing to be desired. A number of their dynamo-machines, of various sizes are driven, by a battery of Robey's steam-engines, of the locomotive type; and the whole arrangement is substantial, neat, and engineering-like.

Further on are the exhibits of the Electric Light and Power Generator Company, a company formed one year ago, and working, in England, the Weston and Maxim American systems of electric lighting. A number of Weston arc lamps and Maxim incandescent lamps are displayed in all kinds of shape and manner, illustrating the numerous adaptations of these forms of lights, and the mechanical portion, which is far away and rather out of sight, also leaves nothing to be desired; the whole of the dynamos are driven, by means of intermediate gearing, by an excellent 20 horse-power nominal semi-portable engine of the firm of Messrs. Ransome, Head & Jefferies, of Ipswich, and of exactly the same type that the one which has been driving, now for three years and a half, the 60 Jablochkoff lights on the Victoria Embankment.

Further on, walking toward the south end of the palace, we meet with the displays of electric lighting of the British Electric Light Company, who are the makers, in this country, of the Gramme Continuous Current Machine and the Brockie lamp. A certain number of these said Brockie lamps are hung from the roof, and give a very good light was it not for the unpleasant jerk periodically given to the carbon pencils from an automatic switch connected with the countershaft driving the dynamo. This system of regulator is also applied by the same company for lighting, outside and inside, the Cannon Street terminus of the South-Eastern Railway Company, in the city—and most effectively, as this is undoubtedly one of the best examples of electric lighting to be found in London. The British Electric Light Company are also lighting some lateral room by means of an incandescent lamp which they are themselves manufacturing on the principles, we belief, of the Lane-Fox system.

Close by is the exhibit of Mr. R. E. Crompton, who shows a certain number of his lamps worked by the Burgin dynamo-machine, which he has introduced in this country. Mr. Crompton is one of the rare exhibitors of electric lighting, or electricians, who do not care to sacrifice appearances to practical results. Simplicity and economy are well studied out and combined by him; and for practical results he cannot easily be outdone, succeeding thereby in obtaining many contracts which are thrown open to public competition.

In the centre of the transept, or at the Handel organ, a number of Piette and Krizik, or Pilsen lamps, are exhibited with very good effect by Messrs. Rowatt & Fyfe, of London; and a great future is predicted for that lamp, which is said to give some very good results.

The next exhibitor is Edison, whose display is very elaborate and striking. The steam engines driving the dynamo in the basement are of Robey's make, locomotive type. The generators are of the vertical type, and the whole mechanical arrangement is well worked out. The light is exhibited in the concert room, in which the lamps are suspended in festoons all round the room, in colored glass in which are imitations of flowers. A great crystal chandelier occupies the centre of the room, and Mr. Edison's name appears above the organ, formed with a certain number of incandescent lamps. Opposite the concert room is the entertainment room, in which the lights are liberally applied in various ways, and harmoniously combined with some pieces of furniture. These, as well as the central "Electrolier" (a new appellation for an electric chandelier), illuminating the body of the room, have been supplied by a firm of Art metal workers, Messrs. Verity & Sons. The central electrolier is a handsome and expensive piece of workmanship (representing a huge basket of flowers, fifteen feet high and nine feet wide, containing about 350 flowers in hammeted brass, and 100 lights in colored glass lily cups); this, with the other electrolier in the concert room, as also the magnificent crystal candelabra just now being erected by the Electric Light and Power Generator Company for a display of their Maxim lamps, seems likely to introduce a style and luxury in lighting altogether unknown or dreamed of during the reign of its elder brother, gas.

On leaving the Edison exhibition, one meets with the exhibit of the Compagnie Générale d'Électricité, who are now working the system universally known as the Jabloshkoff candle. This system is too well known to be described here. The said company's exhibits are somewhat spread about, 20 lights being used for lighting a long passage on the first floor, and in which are to be found sundry exhibitors; 13 lights in the Opera Theatre, a central crystal chandelier being arranged to received four globes, and the nine remaining ones being disseminated about the room in a very elegant fashion; 6 lights in an alley close by; 29 lights in another part of the building, and 30 for lighting the platform and approaches of the London, Brighton & South Coast Railway station. The engine working these latter ones is erected in a small wooden shed, built on purpose in the garden of the palace close to the station, and is a 10 horse-power nominal of Messrs. Marshall & Sons, of Gainsborough, a firm who have acquired a notoriety for the construction of steam-engines adapted for the driving of dynamo-electric machines. The other dynamo-electric machines, all of the Gramme self-exciting, alternating current system, of which the Compagnie is the proprietor, are driven, two by one 12 horse-power "Otto" gas engine each, of Messrs. Crossley Brothers' (of Manchester) make, the other from a 10 horse-power horizontal engine

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coupled with a vertical boiler, the makers being Messrs. Hindley, of Bourton; these makers are also driving one Siemens machine, and will shortly drive some Swan incandescent lamps. The Jabloshkoff system there, as in the thousands of places where it has been in use for long periods of time, gives great satisfaction, its great quality being extreme simplicity.

Then are to be found Messrs. Siemens Brothers' exhibits, which, as far as lighting goes, consist mainly of the wrought-iron, nickeled, eight-lamp chandelier which they exhibited in Paris, and which, with its eight lamps attached thereto, illuminates the crystal fountain and basin at the south end. Siemens' dynamo machines are driven, throughout the building, by almost every kind of engine. We should not, however, fail to notice those of Messrs. J. & H. Gwynne, of Hammersmith, both of the horizontal and vertical type, which run at almost incredible speed, one being scarcely able to distinguish the running parts. These machines drive the dynamos direct.

Another interesting high-speed engine, also largely represented at the exhibition, is Hodson's rotary engine, which is extensively used for driving the dynamos direct.

There are, besides, many other systems of electric lighting exhibited, some quite new, others a little more known. Messrs. Galloway, of Manchester, exhibit a splendid horizontal engine, which is driving a large portion of the exhibitors' machines; Mr. Elmore has a large exhibit of his electro nickeling processes by means of the Weston electro-plating machine.

When I shall have added that the Hammond Electric Light Company are lighting, with the Brush lamp, the long passage leading from the palace to the low level station; that Edison is fitting up lamps for lighting up the space between the palace and the high level station; that the other electrical exhibits are not yet in a sufficient state of completeness to be advantageously noted, I shall have fully described the exhibition as it now stands.

THE FAURE ACCUMULATOR OR SECONDARY BATTERY.

The 9th of June, 1881, the newspaper, *The Times*, published a long and sensational letter, addressed by Sir William Thomson to the editor, on the subject of the storage of electric dynamic energy. Sir William Thomson, in it, announced some wonderful results which he had obtained with a "marvellous box of electricity" which he had received as early as the middle of the previous May, from Paris, and which had been charged in that town. The Faure cell, secondary battery, or accumulator, has been too often described and is too familiar to any one to suffer by being described again in this place. Suffice it to say that, after that lapse of time, during which some public demonstrations of the power and various uses of the accumulators have been given, and the business brought up to a sufficient state of ripeness, the natural sequence has just been arrived at, viz., the formation of a company. The formation of a company for the working of the Faure accumulator has been an accomplished fact for the last fortnight, and it to-day comes before the public in the columns of the daily newspapers. The name of the company is "The Faure Electric Accumulator Company, limited." The capital is £1,000,000, in 80,000 ordinary shares at £10 each and 200,000 deferred shares of £1 each. Subscriptions are invited for 40,000 ordinary shares. The new company, who are purchasing the rights of the "Société Force et Lumière," will pay to the vendors the sum of £25,000 cash, and 100,000 deferred shares of £1 each, fully paid.

We have quite recently heard of another company about to be started and launched, for working a new accumulator, which is said to be far superior to anything of the kind in existence. The promoters are said to be some influential gentlemen already very successfully connected with an existing electric lighting company. We shall see and will not fail to report when it comes out—should it come.

INTERNATIONAL LEGISLATION RESPECTING SUBMARINE TELEGRAPHY.

Public attention is now engrossed, and this in a very serious manner, upon the question of protection to the submarine cables. The industry of submarine telegraphy, although a comparatively recent one, has received continuous and steady development, and is now an immense institution, in which a large capital is invested, and to which the commercial world, and, in fact, the community at large, is greatly indebted. Now that submarine cables are being multiplied, and growing to be in such numbers that casualties to one of them are of almost daily occurrence, some new and unexpected difficulties have presented themselves, which it is impossible to satisfactorily settle in the absence of any international legislation.

It appears that whenever a fault has been discovered and localized in a cable, should one or more cable-repairing ships proceed to pick up the cable where it is discovered to be interrupted, in order to repair the said cable and re-establish the connection between the two ends, the said ships have to labor under all kinds of difficulties, often vexatious and sometimes ruinous, having to abandon, sometimes for weeks together, the idea of repairing the cable, letting, therefore, the communication remain interrupted.

The principal cause of complaints and annoyance is said to be the fishermen, their nets and their boats, whole fleets of which are of course to be found at sea during the fishing season. It appears that fishermen will not exert ordinary care in trawling. They will drag against any cable; should their nets or anchors foul a cable, they will quietly raise the cable if they can, cut it in two in order to free their nets or appliances, and drop the two ends back into the sea; or they will let loose or sink buoys used for marking the ends of cables actually under repairs; then they utterly destroy cables by using trawls in bad repair, and from which sharp pieces of iron or bolts protrude, Another source of annoyance lies in the fact that a cable ship is under regulations to adopt, when at work, the "not under control" lights, and being thought to be a wreck by the passing vessels, those make up for the cable ships and seriously interfere with their work, sometimes totally disabling their cables.

Basing a protest under these various grievances, fifteen large submarine companies have recently petitioned the Minister for Foreign Affairs upon the subject, complaining at the same time that the additional outlay directly and indirectly occasioned, and the loss of revenue caused, pressed heavily upon the companies; that the capital invested, now amounting to £25,000,000, is unfavorably affected, and the whole system, as described, operates to discourage those enterprising investors who have placed this country beyond question at the head of telegraphic enterprise.

Later on, at the end of December, a reply was addressed to Mr. John Pender on behalf of various submarine companies, by the President of the Board of Trade, to whom the petition previously mentioned had been referred.

In it, all the points raised in the petition are argued one after the other, the writer taking an opposite view of the matter submitted to him, and in conclusion it is said that if the petitioners will, after consideration of the observations submitted, prepare some definite answers and suggestions, the president would be happy to receive a deputation, should they desire a personal interview.

Quite recently, the submarine companies have again addressed to the Board of Trade, through Mr. J. Pender, a letter in which they suggest the enactment of certain provisions for the protection of submarine cables. Meanwhile the question is taking the proportions of an international one; France and Germany having also taken it up quite recently. A congress is suggested. We will keep our readers well informed of the progress of this interesting question.

THE ELECTRIC LIGHT IN PARLIAMENT.

Very long is the list of electric-light companies, gas companies, corporations, municipal and local authorities, etc., who are this session presenting themselves before Parliament with private bills, asking for powers to break up the streets and other thoroughfares, to interfere with public and private property, to manufacture and deal with the electric light and electric motive power.

Very strong and well organized also will the opposition to the granting of these bills likely be, and especially on the part of gas companies. A weak point in their argumentation, however, exists in the fact that many gas companies do not think it under their dignity to apply for exactly similar power as if they were nothing more than mere and common electric lighting companies. Black sheep are of course to be found everywhere, even in the bosom of gas companies' organizations. It would be interesting to know if the number of these would not be increased were

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not the majority of gas companies precluded, by their statute, making applications for such powers.

The question of granting powers for electric lighting purposes is giving rise, with the public, to a great deal of speculation, as it involves the right of breaking up streets; and a great inconvenience is already felt at the amount of varied purposes for which streets are already liable to be cut open, there being frequent occasions to disturb them for the gas, the water, the pneumatic post, the telegraph, etc.

From what occurred recently in the House of Commons, the government will shortly introduce a bill proposing that all the electric lighting bills now before them be referred to a joint committee of members of the Houses of Lords and of Commons, or to a hybrid committee, according to what will be found the most convenient; and we may therefore expect shortly a parliamentary committee to sit upon the question, and there is little doubt that the proceedings will prove of the utmost interest.

The report of the future committee will form a worthy complement to the one already issued by a select committee of the House of Commons, who sat upon the very same question of granting powers for electric lighting purposes, from the 17th of April to the 13th of June, 1879, and these documents will form a real historical record of the beginnings of the electric lighting industries in this country. We shall, of course, carefully watch the said proceedings and duly report thereon. *β.*

ANSWERS TO CORRESPONDENTS.

BY WALLACE GOULD LEVISON.

I. S. H.—Q. Where can I obtain report of the recent lightning-rod conference in England, alluded to in your March number?....A. Of E. & F. N. Spon, 446 Broome street, New York.

W. M. B.—Q. Why has a magnetic current from a Telephone Bell Generator no effect on a galvanometer wound with No. 36 copper wire?.... A. Probably, because the current (which is an electric and not a magnetic current) is an alternating current and affects the needle first one way and then the other with such rapidity that it has not time to move. If closely watched the needle will be seen to twitch.

T. J. L.—Q. What are the best works for a person to read who wishes to make a thorough study of electricity from the foundation?... A. One good general work, such as Becquerel's "Traité d'Électricité et de Magnetisme," Paris, 1855, is sufficient. An abstract of this in English is given in the Scientific Memoirs of Mr. Richard Taylor. It is necessary then to read all the separate works on special applications of electricity, such as Hospitalier's "Les Principales Applications de l'Électricité," "Clark and Sabine on Electrical Measurements," "Haskins' Galvanometer," "Davis and Rae's Electrical Diagrams," etc., etc.

H. C. S.—Q. Who patented the first electric telephone after Bell's '77 patent, and what was the date of the patent?....A. Patents relating to the telephone were issued in the following order: 1. Bell's patent, No. 186,787, Jan'y 30, 1877, is probably the one referred to; 2. Local Circuit Breaker for Electro Harmonic Telegraph, E. Gray, No. 194,671, Aug. 28, 1877; 3. Telephone or Speaking Telegraph, J. J. McTighe, Nov. 20, 1877; 4. Telegraph Telephonic, T. A. Edison, No. 198,087; 5. Telegraph Telephonic, T. A. Edison, No. 198,088; 6. Telegraph Telephonic, T. A. Edison, No. 198,089, all Dec. 11, 1877; 7. Receiver for Electro Harmonic Telegraph, E. Grey, 198,379, Dec. 11, 1877; 8. Morse Telephonic System of Telegraphy, E. Grey, No. 198,378, Dec. 18, 1877; 9. Telephone or Speaking Telegraph, J. J. McTighe, No. 198,406, Dec. 18, 1877. No 3 was probably the first telephone patent, strictly speaking, after Bell's '77 patent.

—— THE GASOMETER of the German Hospital at San Francisco blew up Saturday night, the 18th, injuring, fatally, fireman Devow, seriously, H. P. Flueger, manager, and slightly, engineer Trenk.

—— IT IS estimated that the total length of submarine telegraph cables in the world is 62,100 miles, having a money value of about $200,000,000.

THE ALPHABET OF BULLS.

IT has often been urged by our European cousins that the American Morse code, or telegraphic alphabet, although more rapid, is proportionately more productive of mistakes than their system, on account of the spaced letters *c, o, r, y, z*, etc.; as the combinations of these letters with each other and the one and two dots *e* and *i* form other signals than those intended to be sent. A striking instance of this is found in *person* and *poison*, which are the same telegraphically if hurriedly transmitted. The American operator however, avoids these difficulties by familiarizing himself with the multiple combinations which, taken collectively might be termed, not inaptly, the Alphabet of Bulls. There seems to be a perversity about the spaced letters, which insist on making themselves heard in wrong rhythm, and it can only be accounted for in a musical sense; for it must be noted that no expert operator hears or listens for individual dots or dashes, any more than a person at a concert takes note of the separate tones of the several orchestral instruments, unless his attention is especially called to it. To the operator, the telegraph sounder speaks in as measured accents as any orator or conversationalist, so when he hears certain combinations which his ears tell him are *yo, brek, civing, reho, bacid, drombe*r, etc., his automatic sense of propriety, following the teachings of unwritten law, bids him put them down as *ice, Beck, Irving, echo, Baird*, and *December*. The question now arises, What is the cause of this imperfection? Is it that poor transmission is so universal? or is it rather that there are musical inductions taking place, which composers notice in certain tones or chords being produced when others are struck, and which they denominate Harmonics? Certain it is, that the *staccato* movement of slow transmission is very annoying to our "first-class" man; his brain craving the *legato* of "pure Morse," which, by the way, is based on no one standard of excellence, depending as it does so much on the musical construction of each individual mind. There is an old saying that "Nature abhors a vacuum," and inasmuch as the one dot letter *e* is the nearest approach to nothing, the ear rejects it, perhaps, as a separate sound and seeks to combine the next two dots of a following letter; hence the confusion arising from the combination of the two. Another curious thing to be noted in this connection is, that words having a similar sound though different in spelling, convey the same impression to the operator's ear. Instances of this may be found in *hear here, their there, Read Reid*, and the operator may often mistake a figure for a written word, especially when duplicated. Thus "ten (10)" conveys the same *sound* as "*ten ten.*" Another class of errors is caused by imperfect contact in keys and transmitters, the "sticking" causing the slurring of the signals, as, for instance, *l* for *m*, "come home" being rendered *cole hole*, etc. Much more might be written on this subject, but enough has been given to show that every operator must be *au fait* in the "Alphabet of Bulls," in order to rank as an expert.

G. C.

NEW YORK, March, 1882.

—— A PANAMA DISPATCH of the 21st states that a cable has been laid from that port to Elena, Ecuador. "No difficulties are in the way of successful cable laying, which will be undertaken by the Central and South American Telegraph Company, as soon as the steamer Silverton, which left London Feb. 18th, arrives at Santa Elena. The cable, with branches and land lines connecting it with the mainland at Panama, now finally decided upon, will be ready under ordinarily favorable circumstances by June 15th next.

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ELECTRIC LIGHT DANGERS.

A CLOSE investigation into the subject of electric lighting and its dangers has just been made by Mr. Edward Atkinson of Boston, in his report to the insurance companies of that city, which is very full and interesting He says: Between the two systems of electric lighting called arc and incandescent the underwriter must give the preference to the latter, which system may, we believe, be brought as near to absolute safety as any method of lighting can be, while the former, we believe, may be made as safe as gas or oil, probably safer, when carefully put up by responsible companies and kept under proper supervision or inspection. We may not at present venture beyond this judgment.

After stating the necessity of keeping telegraph, telephone, or other wires free from contact with electric light wires, he refers to another danger as follows:

There is another danger which may also be easily avoided, but which notice should be taken of at once by every one using the electric arc light—namely, it appears that if the wire conveying the current is suddenly fractured while the dynamo machine is in operation the voltaic arc may be extended, while the ends of the wire are slowly separating in still air through a considerable distance, varying according to the power of the machine; that is to say, if the wire is broken at such a place that one end can fall or separate from the other, the arc, or what would be called in common speech the electric spark, may follow from one broken end to the other to a considerable distance, varying according to the current generated. If in that distance the current should pass through or come in contact with wood or any combustible material, especially loose stock or fibrous material, fire would instantly occur. Such an arc might also, and probably would, be dangerous to life if a person were exposed to it. A fracture of the wire may be occasioned by the breaking of a belt, by the rupture of machinery, by a careless mechanic working in the neighborhood of the wire, and by many other causes. The greatest care should therefore be taken in choosing the position of the wires, and they should never be carried along the underside of the beams or the transverse thereto, nor in any proximity to belts, shafting or pipes. The danger of suspended wires exposed to the action of machinery will be apparent.

His suggestions in regard to dynamo machines, wires, arc lamps, incandescent lamps, and on the method of placing wires, are very suggestive and practical, and will be referred to hereafter.

The report in conclusion states that it appears to be conclusively proved that at the end of a day's work the operatives in a mill who have worked some time by an electric light are more alert and in better physical condition than those who have worked by gaslight—the atmosphere being cooler and not being vitiated by the products of combustion.

—— THE FOLLOWING is from the *Times of India*: "During the repairs of the telegraph cable near Bombay, the steamers Chiltern and Great Northern were about half a mile apart, the former having hold of a shore end cable, and so was in telegraphic communication with Bombay; the latter having hold of a sea end, and so was in telegraphic communication with Aden. The Chiltern desired the Great Northern to splice on to the cable-end held by the latter, and pay out three-quarters of a mile of cable, and this was communicated by wire from the test-room of the Chiltern, passing through all the coils of cable in her hold and on to Bombay, whence it was sent on to Aden, and back from Aden to the Great Northern, Thus, as a speedy means of sending a message half a mile, it was forwarded by a route between three and four thousand miles long. The following morning, when the two vessels were within a quarter of a mile of each other, communications passed between them constantly in the same way."

IT IS STATED that the United States Underground Telegraph Company in this city has been organized to work the French patents now in use in Paris, and under which system all the wires are laid underground in that city.

PHOSPHOR-BRONZE TELEPHONE WIRE.

To the Electrician:

THE use of phosphor-bronze wire for telephone service is constantly extending, as this new material offers many advantages over iron and steel.

The greatest points in its favor are its great strength, durability, and resistance to the corrosive action of the weather, sea air, smoke, acid fumes, dampness, mine water, and other deteriorating influences to which the wires are exposed and which are constantly acting upon and destroying iron and steel.

The greater tenacity offered by steel over iron, the desire to reduce the cost, and the weight and strain upon supports, have led to the use of fine steel wire by many electrical engineers; but these advantages have been met by rapid deterioration from the causes mentioned, so that the life of number fourteen wire is reduced to about four years, while in many exposed places it scarcely exceeds two.

In the first introduction of phosphor-bronze wire in this country, following the example set in Europe, smaller wires were employed than are now considered advisable to use, but by substituting sizes weighing from 40 to 66 lbs. to the mile the best results are obtained. The wires kink less, splices hold well, resistance is reduced, and any increase in first cost is compensated for by greater durability and the permanent value of the material which will be realized when the wire is finally taken down.

An objection was also made by competent engineers to its high resistance, but this has been overcome by a new wire with but about one-half the resistance of iron wire of equal size.

Tests of conductivity have recently been made by Mr. W. D. Sargent, electrical engineer, Philadelphia, which we are kindly permitted to give as follows:

Gauge.	*Diameter.*	*Weight per Mile.*	*Breaking Strain.*	*Resistance of 106 Feet.*	*Calculated Resistance per Mile Phosphor-Bronze.*
16	.065 in.	66	270	1 ohm.	50 ohms.
18	.049 in.	40	165	1.8 ohms.	90 ohms.
20	.035 in.	20	85	3.8 ohms.	190 ohms.

Calculated Resistance per Mile.	*Per Cent of Conductivity.*	
Pure Copper.		The per cent. of conductivity of iron and steel wire is given by Latimer Clark as "about 15 or 16 per cent."
15.34	30.69	
25.32	28.13	
50.64	26.13*	

How long phosphor-bronze wires will last is, of course, still undetermined; but when it is known that they possess greater strength than iron of the same size, that they resist corrosion while they are not liable to stretch, that their electrical conductivity is double that of iron, and that by their use dead weight and strain upon supports is reduced to a minimum, it will be seen that they possess all the qualities desired for a permanent and effective aerial wire.

Phosphor-bronze wires are found very convenient for running over house-tops where the supports can be but slight, and where lines congregate at stations and exchanges they are not so unsightly as the larger iron wires, while the same supporting frames will be strong enough for double the number.

H. S.

—— PRIOR TO THE INVENTION of the photophone, M. Tréve (in 1879) is credited with experiments of an opposite character to those which developed this instrument. Instead of turning light into sound, he transformed sound into light. According to *Les Mondes*, a Fizeau condenser, consisting of sheets of paper alternated with tin foil, was rolled up and placed in a Geissler tube, which was connected with an air pump. The current from a Ruhmkorff coil was passed into the tube, and a telephone was placed in the induced circuit. While the current was passing, the sound produced by the electricity in the condenser could be heard in the telephone. If the pressure of the air in the tube was gradually lowered by the air pump, the noise died away, and when a vacuum of from two to three millimetres had been obtained, the noise ceased altogether, and light began to play against the leaves of the condenser.

* The variation of the percentage of conductivity is probably due to the greater density of the smaller wires.

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SPARKS.

—— LONDON, Ontario, will start with six electric lights.

—— SAN ANTONIO, Texas, will use electricity for street illumination.

—— THE DEPOT at Springfield, Mass., will be lighted by electricity.

—— A TELEPHONE EXCHANGE will be established at Waseca, Minn.

—— PLAINFIELD, N. J., is obtaining subscribers for a telephone exchange.

—— THE COURT HOUSE at Williamsport, Pa., is to be illuminated by electric light.

—— UNDERGROUND telegraphy has had a successful trial in Philadelphia, as well as in sundry European cities.

—— THE LEHIGH VALLEY RAILROAD will introduce the electric light into its shops at Sayre, Pa., at an early day.

—— A NUMBER of prominent citizens of Hyde Park, Ill., are discussing the feasibility of introducing electricity for street lighting.

—— THE CUSTODIAN of the United States Custom House, at Chicago, will receive proposals for lighting the building with either gas or electricity.

—— M. CHAPPUIS, of Paris, has asked permission of the Municipal Council of that city to establish an overhead electrical tramway in Paris at his own expense, and as an experiment.

—— THE TOWN of Uxbridge, the most important grain market in England, is to be lighted by electricity, the town council having appointed a committee to make the necessary arrangements.

—— THE CAJON IRRIGATION COMPANY, Anaheim, Los Angeles County, California, talk of erecting a telephone line along their ditch, a distance of about twenty miles. The estimated cost is about $500.

—— THE *London Electrician* says that the powers of the electric light are shown to better advantage by one single Weston lamp in one side of the courts at the Crystal Palace Exhibition than in any cluster or array of lamps in any other part of the building.

—— A GUEST at the International Hotel, Boston, on the 19th, died from the effects of gas, which escaped into his room. The conclusion is drawn from the fact that the escaping gas came through a rubber tube attached to a burner, the tube hanging directly down beneath the gas fixture.

—— ON MARCH 11th a workman at the Cleveland, O., rolling mill was instantly killed by an electric shock from a Brush dynamo machine. He had been repeatedly warned not to touch the machinery. From his position when found it seemed probable that he had touched the brushes of the machine.

—— THE *Journal of Chemical Society*, London, says it is found that the substitution of a solution of sodium or ammonium chloride for the dilute acid in a Bunsen cell is an improvement. The zinc need not be amalgamated. A solution of one part sodium sulphate in five parts water may, with equal advantage, be substituted for the dilute sulphuric acid in both Grove's and Bunsen's cells.

—— A DISPATCH from Coatesville, Pa., dated February 23d, says: By the explosion of a lamp in the Rokeley paper mills of J. B. Broomell, about three miles from this place, at three o'clock this morning, the mill and an adjoining dwelling were burned. Ellwood Hilton, one of the employees, who was sleeping in an upper story, was burned to death. Loss, $20,000; insured for $10,000.

—— THE BURSTING of a gas pipe in St. Mary's Church, Endicott street, Boston, during the services held on the 10th, caused considerable excitement which, for a few moments, threatened to result seriously. The fears of the nervous ones were allayed, however, in time to prevent a stampede. The pipe referred to was some feet above the heads of the congregation, on a pillar. The damage was slight.

—— A FRENCH STATISTICIAN has calculated that if all the telegraph wires at present laid were tacked on end to end they would reach forty-six times round the world. Belgium has a greater telegraph mileage in proportion to its superficial area than any country in Europe. Switzerland comes second, and Great Britain third. Russia has the least.

—— ON MARCH 13th a fire was discovered in the engine-house of the Municipal Gas Company's works, at the foot of West Forty-fourth street, this city. The house is a small two-story brick structure, which adjoins the main building, and had the flames not been so opportunely discovered, it is difficult to surmise the extent of damage that would have been done, for in this immediate neighborhood is located the largest gasometer in the world.

—— AT A MEETING of representatives of sundry telephone companies, lately held in London, Mr. J. Pindar, M. P., remarked that the Oriental Telephone Company is ahead of all other companies in India, Australia, and other British colonies, though it has been in existence less than two years. In Egypt, that company has already fifty subscribers at Alexandria. In Oceanica, in the city of Honolulu, the company has seventy-five subscribers.

—— A COMPANY was organized in Quincy, Ill., for the purpose of introducing the electric light, but the council refused permission to erect poles and stretch wires. The company resolved to have an exhibition, and obtained permission to use the dome of the Court House. On the 16th the engine started, and every night during the following week the vicinity was brilliantly illumined. The effect on the obdurate council remains to be seen.

—— ON THE 10th inst. a farmer from Iowa retired at the Bridge Hotel, this city, at 11 P. M. On the following morning there was a smell of gas in the hall, and the door of his room, which was locked, was forced. The room was full of gas, and he had been dead a number of hours. There is no reason to suspect suicide. On the same day a man was found dead in his bed at the North River Hotel, in Barclay street, with the gas turned on.

—— AT CINCINNATI, on the 9th, a man working in a slaughter-house went into the basement to remedy some trouble with the sewer-pipe. He lit a match when he had reached the bottom and in an instant was enveloped in flame; he was badly burned. The origin of the fire was found to lie in a broken gas-pipe, from which the gas had been escaping for some time. The gas company was at once notified, and promptly repaired the break.

—— IN A BUILDING on Purchase street, Boston, a gas explosion occurred on the 10th. It is supposed that gas got into the basement of the building from a broken street main in front. It was during a search for the leak that the explosion occurred. A door was blown off its hinges, and the report was sufficiently violent to cause a rare commotion among occupants of the structure and others adjacent thereto. The damage, however, was small compared with the noise and excitement.

—— AN ITEM from Alexandria, Va., says that two hotel guests, in different houses, were found nearly suffocated, having blown out the gas flame before retiring,. The same accident has twice happened before within the past sixty days at hotels here. When gas was first introduced in 1853, the trouble from this source grew so serious that the city council placed in the city laws a provision: "The gas should not be blown out but turned off at the spigot." This provision is still a part of the city code.

—— ON THE 27th ult., at Chicago, a loud explosion occurred in the Union Building, in which the general offices of the Associated Press and the Western Union Telegraph Company are located, shaking the entire building, knocking out the heavy plate glass from the windows in all parts of the building and demolishing the woodwork, doors and plastering. The explosion was caused by a boy named James Brett entering one of the vaults, where the gas had been escaping since Saturday, with a lighted match. He was seriously, if not fatally, injured.

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—— AN INTERESTING EXPERIMENT in photographing by the electric light was made recently by Mr. Liebich, a Cleveland artist. Monumental Park in that city is lighted by an electric light upon a mast 250 feet high, and by the aid of this light Mr. Liebich took an excellent picture of the Perry monument and its surroundings. Every feature in the view is finely brought out, even the distance being as clear and distinct in details as though photographed in the sunlight. The picture of the monument itself is remarkably good. The photograph was obtained by the exposure of gelatine bromide plates for four hours. Other experiments are to be made.

—— THE CITY OF PARIS on the 11th of March narrowly escaped a calamity almost as terrible as that which visited Vienna a couple of months ago. Four workmen were examining the gas meter in the cellar of the Opéra Comique at five o'clock in the afternoon, when, through some carelessness on the part of one of the men, the gas ignited, an explosion followed and the basement of the theatre was instantly wrapped in flames. Help was happily soon obtained, and in a short time the fire was extinguished. But for the gallantry of a gasfitter, who braved almost certain death to turn off the meter, the whole building and the adjoining house would have been blown to atoms.

—— AT HATFIELD PARK, the seat of the Marquis of Salisbury, piles to support a coffer-dam across the river Lea have just been successfully driven by the power of a water-wheel situated at a distance, which power was transmitted by two dynamo machines to the gearing connected with the pile-driver of ordinary construction erected on a barge floating in the river. The machinery worked well, lifting a monkey weighing about four hundredweight with ease and regularity. It is not stated how far the power was transmitted. By a French experiment, M. Deprez has succeeded in obtaining useful work after the current had passed through forty-nine miles of ordinary telegraph wire.

—— THE *New York Sun* says: The business done by the gas companies of London last year was the best they ever had. The New York companies also paid large dividends in 1881, and their stock has uniformly and greatly advanced in market value. Instead of being injurious to the business of the gas companies, the electric light has been to their advantage. It has kept other competitors out of the field, and has itself produced only a slight effect. Yet their stocks are still down to lower figures than their earnings seem to justify, because the public have not lost faith in the ultimate success of the new light, and believe it is destined to become a powerful rival of gas.

—— THE SAN DIEGO *Union* pays this tribute to the value of the telephone in Southern California: A very singular accident happened a few days since to the little boy of D. C. Reed. It appears that he was playing in a tree, when he fell, with his neck in a fork, hanging by his head. His cries soon brought his mother to his rescue. But she failed to relieve him, when she attempted to sever one of the limbs with an axe, for the jar caused the little fellow so much pain that she was compelled to desist. She then rushed to the telephone and summoned Mr. Reed, who drove like a Jehu out to his home, over a mile, and released his little son from his perilous position. Mr. and Mrs. Reed are now more convinced than ever that the telephone is a most valuable "institution."

—— M. LAUS, of Paris, gives the following account of the use of electricity in the mines of the Loire district. The current is brought by wires to the depth of 1,500 yards, where it drives machines and helps the miner in various ways. It will soon not only light up the mines but will be employed for rolling the productions. M. Charousset has made an application of the current to working the La Peronnière mines. Two Gramme machines, each of eight horse-power, work a windlass placed at the top of an inclined plane of one hundred and ten yards. The Gramme machines are in the open ground above—1200 yards distant. The load that is carried up by the machine is 2,000 lbs. No accidents are to be feared from derailment. A galvanoscope, placed on the circuit and in the room of the exterior machines, shows at once what is going on below, whether wagons are full or not, or the workmen attending to their business.

—— A SMALL BOAT, entirely built of phosphor-bronze, was lately launched on the Thames. It is not over twelve feet long and five in wide. It ran at the rate of some thirteen miles an hour, which is a very remarkable rate of speed, considering the dimensions of the boat. The Phosphor-Bronze Company, to which the boat belongs, wished to make this experiment before attempting larger constructions, and to ascertain how the plates and fire-irons would comport themselves. The trial was satisfactory in every respect, both as to rigidity and absence of vibrations. Although the cost of the new material is rather high, it is thought that this use of a non-oxidizing metal will be of advantage in the construction of steamers, torpedo-boats, etc.

—— ELECTRICITY IS NOW used in porcelain factories to obtain a perfectly white paste. Magnets had been experimented with to this end, but it is only within a short period that Messrs. Pilliwuyt, of France, have obtained satisfactory results. The pastes, in a liquid state, are run before very powerful electro-magnets driven by a Gramme machine. The poles of the two electro-magnets are placed opposite each other, and between each of these magnetic groups is a kind of funnel, the poles of which act on the mould in which the liquid runs. Twice a day the surface is cleaned of the ferruginous particles that adhere to it. Upward of two thousand and eight pounds of paste can be purified daily by this process, which gives the manufactures an additional value of forty per cent.

—— M. WEIL has perfected his electro-chemical processes. He has coated all metals and alloys instantaneously, and at the ordinary temperature, by means of a single copper bath. The coating is adherent and of the most brilliant shades of the various sub-oxides of copper, steel and brass, and all the precious metals are given brilliant coatings of any desired color. These multi-colored metallic deposits are either plain or changeable, all depending on the way in which the pieces are exposed to the electric action. These colors, which are remarkable for their fastness, are due to the sub-oxides of copper, and not the effect of their plates, as has been proved by the experiment of covering such a multi-colored piece of metal with a coating of pure copper by the nascent hydrogen process.

—— LOCOMOTIVE HEADLIGHTS.—"The problem of lighting railways may now be regarded as solved." Such is the rather enthusiastic introduction with which the *Suddeutsche Presse*, of Munich, prefaces a brief description of an electric locomotive headlight recently tested on one of the French railroads. The apparatus is the joint invention of Messrs. Sedlaczek, Wikulill and Schuckert, but it is briefly styled the Sedlaczek lamp. This lamp can be set up on the front of a locomotive, like the usual oil lamps, and it is not affected in the least by the jolting of the engine. A small steam-engine feeds the lamp through an electric motor. This special engine is necessary, because when a train is nearing a station the locomotive engine works more slowly and at the station stands still. Were the lamp dependent on the locomotive it would cease to give light precisely at the points where light is most needed. The Sedlaczek lamp lights up the track for a distance of three or four thousand yards ahead.

—— FROM THE *London Times* of a recent date we clip the following: Some interesting and successful experiments in the subdivision of the electric current were shown on Monday afternoon to a party of gentlemen who visited the works of Mr. Rogers, of Farringdon street. Mr. Rogers claims for his invention that it will enable him to supply electricity for domestic purposes as water and gas are now supplied; and that from a cistern, to which the current must be conducted by the main wire, and which may be compared to a gas meter, separate wires may be carried to every room in a house. The novelty of the system, for other methods of subdivision exist, lies in the ease and completeness with which the current is distributed over the wires, and in the fact that it is rendered almost infinitely divisible without much loss of power. A town can now be supplied with water by a mere ramification of pipes, and, following this idea, the inventor of the system we are sketching,

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whenever he desires to subdivide the current of any given wire, collects it in a small cistern or reservoir, from which it issues again through as many wires as it may be necessary to attach. Thus, in lighting a large building by electricity the main wire would convey the current to the chief cistern on the ground floor or in the basement, whence it would be distributed among subsidiary cisterns, of which there would be one or more on each floor of the house, and these in turn would transmit the divided current to each separate room. The experiments made on Monday demonstrated the efficient action of the cisterns or reservoirs, on which the success of the whole system depends, and showed that the current of a single pair of wires could be made to supply an indefinite number of lamps. Edison lamps were used, and received the current from six cisterns, the subdivision being such that it mattered not whether each cistern supplied one lamp or half-a-dozen. This, it must be admitted, is one method, and not an unsatisfactory one, of solving a problem that has long vexed practical electricians. An ingenious modification was also shown of the apparatus known as Barker's mill for driving a dynamo-machine by water power, with a governor so contrived as to insure the application of an unvarying degree of force, and by consequence a perfectly even and unfluctuating electric current.

BUSINESS NOTICES.

MESSRS. BURKE, CONNETT & FRASER, solicitors of American and foreign patents, at No. 10 Spruce street, New York, are publishing a quarterly circular of information and advice relating to patents on inventions for the free use of their clients. The March number contains articles on Reissued Patents, Duration of United States Patents, Trade Marks, Extension of Patents, The Use of Parchment, Foreign Patents, Commissioner's Report for 1881, and Decisions of the United States Courts.

WE CALL ATTENTION to the advertisement in another column of the "Cumming Periphery Contact," which is applicable to electrical machinery. This novel form of electrodes received a medal at the Paris Electrical Exposition, and is now on exhibition at the Crystal Palace, London (Edison department). Mr. Cumming has in his possession several hundreds of autographic testimonials from experts, placing its merits at the highest, and he has been made a member of the French *Academie Nationale, Ag., Mfr. et Com.* in recognition of the merits of the invention A full description of the key, with claims at length, was published in the January number of the ELECTRICIAN, to which our readers are referred. An illustrated circular can be obtained by addressing the inventor, Geo. Cumming, 303 East Nineteenth street, New York.

WE DESIRE to call attention in another column to the advertisement of the Humboldt Library, published by J. Fitzgerald & Co., 143 Fourth Avenue, N. Y. This work is undoubtedly the cheapest and best publication of its kind in this country. Its low price places the writings of the best authors within the reach of all. The March number is particularly valuable, containing Part I. of "The Study of Words," by RICHARD CHENEVIX TRENCH.

Archbishop Trench's work is universally admitted to be at once the most learned and the most interesting treatise we possess upon the origin and use of English words. It is simply indispensable to every one who would acquire a mastery of his mother tongue. The diffusion of such works contributes not only to correctness in speaking and writing, but even more—to precision in thinking The present edition is the cheapest ever offered of this standard work It is comprised in two parts, price only 15 cents each. Part II. will be published in April.

MESSRS. E. & F. N. SPON, of 446 Broome street, this city, have recently published two valuable works on electricity: the first, the "Lightning Rod Conference," containing report of the delegates from the Meteorological Society, Royal Institute of British Architects, Society of Telegraph Engineers and of Electricians and Physical Society, with a code of rules for the erection of lightning conductors. The object of this conference was to give (as the preface of the work indicates) official sanction to the best known means of protection from the ill effects of atmospheric electricity. The second work is "Candle-power of the Electric Light," by Paget Higgs, LL. D., D. Sc. Its contents are particularly interesting, inasmuch as some mooted and troublesome points with electricians are ably treated, viz.: "Comparison of various Arc Lights," "Comparison of various Incandescent Lights," "Economical Ratio of these Systems of Lighting," "Relation of Lighting Power to Quantity of Current," and "Source of Loss in Existing Lamps."

PATENTS FOR FEBRUARY, 1882.

FEBRUARY 7th.

253,387 Electric Machine, Dynamo. Chas. A. Hussey, New York.
253,435 Electric Store-boxes and Lights, Regulator for. H. B. Sheridan, Cleveland, Ohio.
253,446 Insulation of Electrical Conductors. H. C. Strong, Chicago.
253,391 Interlocking Switch and Signal Mechanism. E. H. Johnson, Philadelphia, Pa.
253,205 Lamp, Electric. A. G. Holcomb, Danielsonville, Ct.
253,322 Lamp, Electric. W. M. Thomas, Cincinnati, Ohio.
253,327 Lamp, Electric. A. G. Waterhouse, New York, N. Y.
253,328 Lamp, Electric. A. G. Waterhouse, New York, N. Y.
253,324 Lamps, Carbon-holder for Electric. John Tregoning, New York, N. Y.
253,382 Magneto Electric Machine. L. Herman, Union, N. J.
253,442 Railway Trains, Electric Apparatus for Producing Signals and Lights Upon. E. T. Starr, Philadelphia, Pa.
10,033 Telegraph Apparatus, Duplex (re-issued). Jos. B. Stearns, Boston, Mass.
10,034 Telegraph Apparatus, Duplex (re-issued). Jos. B. Stearns, Boston, Mass.
10,035 Telegraph Apparatus, Duplex (re-issued). Jos. B. Stearns, Boston, Mass.
253,366 Telegraph Table, Revolving. J. L. Garber, Greenville, Ohio.
253,419 Telegraphs, Electric Coupling for Train. E. D. Parker, Salina, Kansas.
253,316 Telephone Exchange System and Apparatus. G. B. Scott, Brooklyn, N. Y.

FEBRUARY 14th.

253,422 Candle for Electric Lighting. Jean Baptiste Java Mignon, Paris, France.
253,783 Clock, Secondary Electric. D F. Sweet, Hastings, Mich.
253,826 Electric Light. A. L. Airey, Cleveland, Ohio.
253,748 Electric Lights, etc., Apparatus for Elevating Poles for. J. D. A. Mensing, Rochester, N. Y.
253,817 Electric Lighting Apparatus. M. G. Farmer, Newport, R. I.
253,529 Electrical Conducting Wires with Metallic Armor, Machine for Covering. W. Halkyard, Providence, R. I.
253,769 Galvanic Battery. A. M. G. Sebillot, Denver, Col.
253,811 Lamp, Electric. A. L. Airey, Cleveland, Ohio.
253,770 Lamp, Electric A. M. G. Sebillot, Denver, Col.
253,776 Lamp, Electric. H. B. Sheridan, Cleveland, Ohio.
253,645 Lamp, Electric. W. L. Voelker, Morton, Pa.
253,646 Lamp, Incandescent Electric. W. L. Voelker, Morton, Pa.
253,647 Lamp, Incandescent Electric. W. L. Voelker, Morton, Pa.
253,577 Magneto Electric Machine. Jno. B. Blair, Chicago, Ill.
253,699 Magneto Electric Machine. M. A. Hardy, Newport, R. I.
253,762 Railway Signaling Apparatus. F. L. Pope, Hartford, Ct.
253,759 Telegraph Signal Box, District and Alarm. G. M. Phelps, Brooklyn, N. Y.
253,643 Telegraph Wires, Supporting. Sam'l Turner, Cincinnati, Ohio.
253,491 Telephone Receiver. G. L. Anders, Boston, Mass.
253,812 Telephone Receiver. S. H. Bartlett and H. E. Waite, Bridgeport, Ct.
253,798 Telephone, Relay. H. E. Waite, Bridgeport, Ct.
253,597 Telephone, Signal Generator. J. F. Gilleland. Indianapolis, Indiana.
253,665 Telephone Transmitter. S. M. Allen, Duxbury, Mass.

FEBRUARY 21st.

254,056 Electric Machine, Dynamo. W. E. Sawyer, New York.
254,099 Electric Wires, Safety Device for. Sam'l M. Plush, Philadelphia, Pa.
254,045 Electro-magnetic Relay. C. A. Randall, New York.
254,082 Lamp, Electric. H. S. Maxim, Brooklyn, N. Y.
254,055 Lamp, Electric. G. W. Sawyer, New York, N.Y.
253,958 Lamp, Electric. E. Thomson, N. Britain, Ct.
253,955 Lantern for Electric and other Lights. L. Stieringer, New York, N. Y.
253,957 Telegraphic Apparatus. B. Thompson and C. Selden, Toledo, Ohio.
254,061 Telegraphic Receiving Instrument. G. Smith, Astoria, N. Y.
253,853 Telephone Call Register. W. J. Denver and W. W. Sawyer, Springfield Mass.
253,912 Telephone Station Apparatus. G. W. Coy, Milford, Ct.
253,941 Telephone Switch. J. B. Odell, Chicago, Ill.
253,977 Telephone Transmitter, Carbon. G. D. Clark, Chicago, Ill.
253,962 Watchman's Electric Register. G. G. Weitz, Boston, Mass.

FEBRUARY 28th.

254,386 Burglar Alarm, Electric. M. H. Kerner, New York.
254,389 Electrical Switch-board. C. E. Scribner, Chicago, Ill.
254,261 Lamp, Electric. F. H. Beers, Newark, N. J.
254,268 Telegraph Line, Underground. D. Brooks, Philadelphia, Pa.
254,297 Telegraph, Quadruplex. S. D. Field, New York.
254,220 Telegraph, Sextuplex. F. W. Jones, New York.
254,155 Telephone Line Signal Call. F. E. Richmond, Springfield, Mass.
254,190 Telephone Transmitter. E. Berlined, Boston, Mass.

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Gordon's Electricity and Magnetism, 2 vols, 8vo	7 00
" Lectures on Electric Induction	80
Harris's Treatise on Frictional Electricity, 8vo	7 00
Haskins' Galvanometer, and its Uses	1 50
Higgs' Candle Power Electric Light, (nearly ready)	
" Construction of Electro-Magnets, (nearly ready)	
" Electric Light in its Practical Application. 8vo	3 50
" Electric Transmission of Power	1 20
Hospitalier—Les Principales Applications de l'Electricite—with many illustrations, 8vo, paper; Paris, 1881	3 50
Induction Coils; How Made and How Used, 16mo	50
Jenkins' Electricity and Magnetism	1 50
" Reports of Electrical Standards, 8vo	3 75
Langdon's Application of Electricity to Railway Working	1 50
L'Eclairage Electrique, par Du Moncel	90
L'Electricite, par I. Baille	90
Loring's Handbook of the Telegraph, boards	50
" do. do. do. cloth	75
" do. do. do. morocco	1 00
Maxwell's Elementary Treatise on Electricity	1 90
" Treatise on Electricity and Magnetism, 2 vols	8 00
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Noad's Manual of Electricity	9 00
" Rudimentary Magnetism	1 80
" Textbook of Electricity	4 00
Pope's Modern Practice of the Electric Telegraph	2 00
Prescott's Electricity and the Electric Telegraph	5 00
" Speaking Telephone and Electric Light	4 00
(These two books of Prescott sold together for $7.00.)	
Sabine's History and Progress of the Electric Telegraph	1 25
Sawyer's Electric Lighting by Incandescence, 8vo	2 50
Schwendler's Instructions for Testing Telegraph Lines, 2 vols., 8vo	8 00
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SCIENTIFIC AMERICAN, Supp., December 17, 1881.
THE ELECTRICIAN (N. Y.), January, 1882.
THE OPERATOR, August and November, 1881.
JOURNAL OF THE TELEGRAPH, August, 1881.
HUMBOLDT LIBRARY, No. 28.
MECHANICAL ENGINEER, March 15, 1882.

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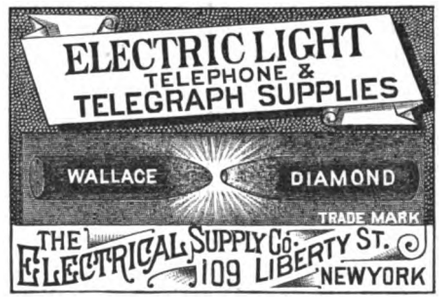

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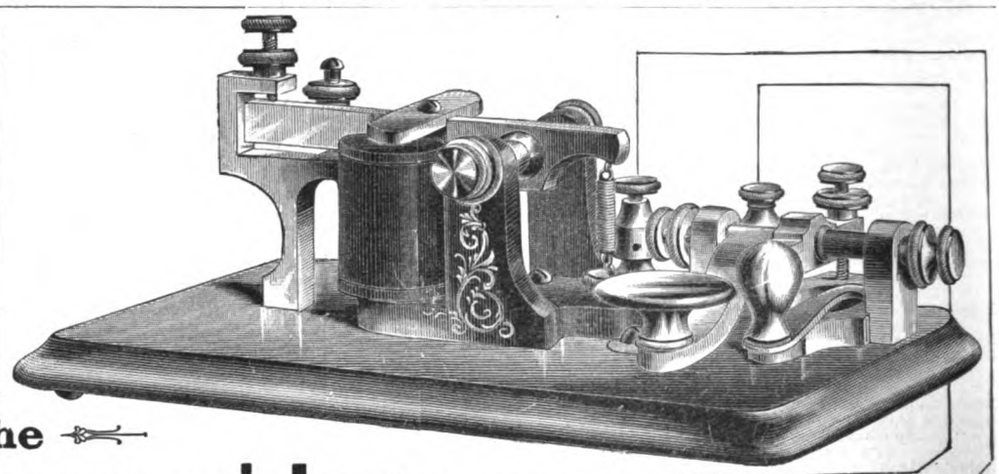

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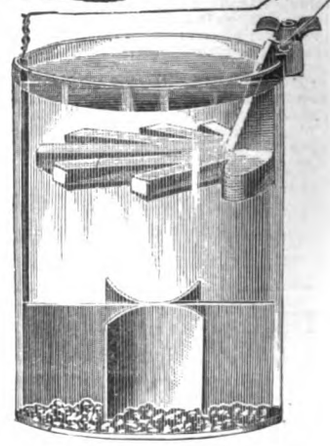

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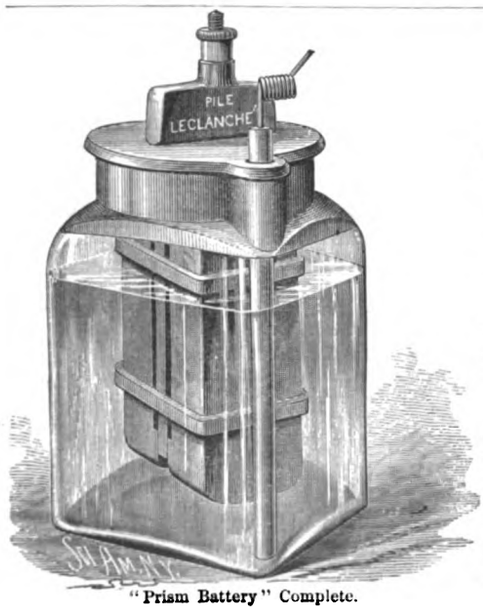

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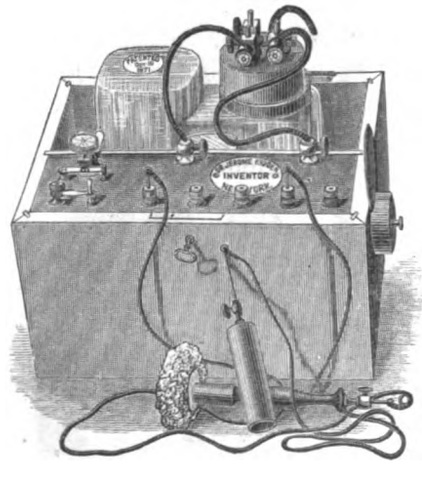

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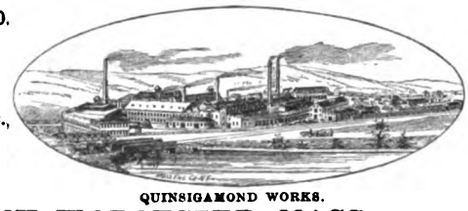

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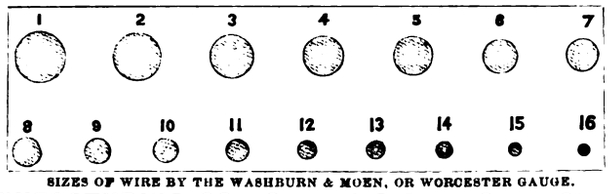

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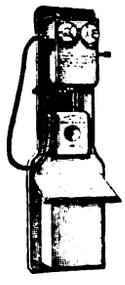

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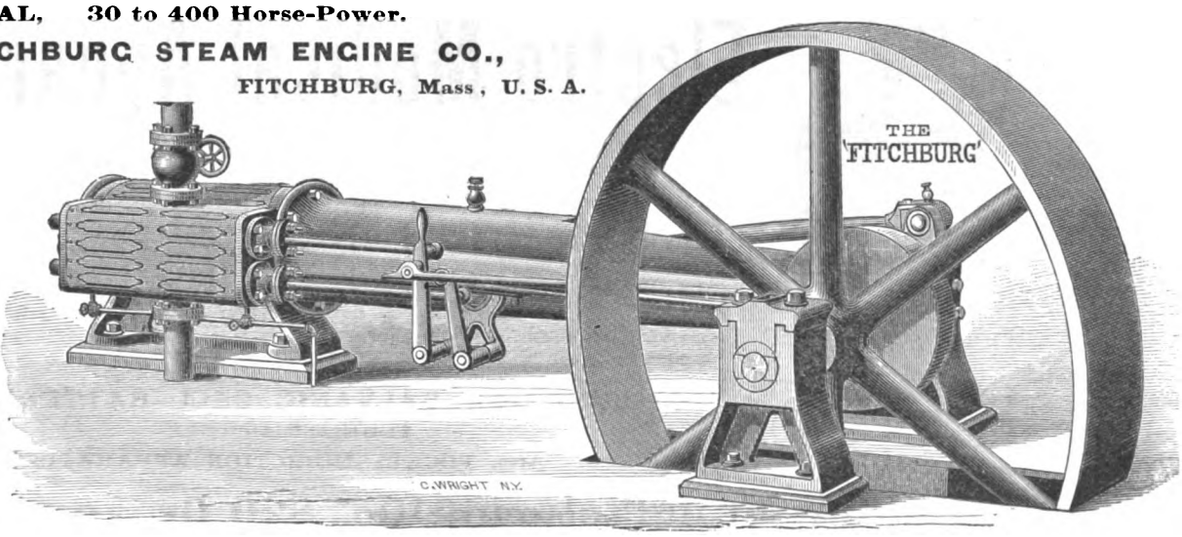

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THE ELECTRICIAN.

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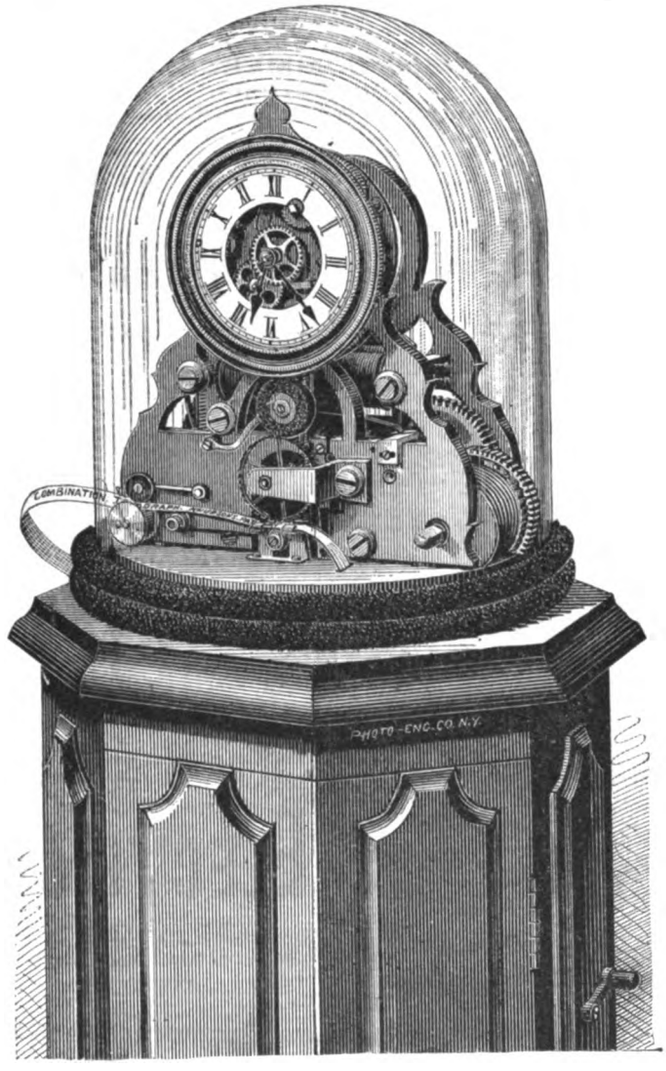
A NEW PRINTING TELEGRAPH.

A RECENT invention of merit and one likely to interest a large body of our business men is the printing telegraph, designed for the use of bankers and brokers (shown in the annexed cut), and patented by Mr. A. A. Knudson, of this city. It combines in one instrument, with the usual stock indicator, a district signal attachment, and a clock which may be relied upon for the same identical time as that given in the Stock Exchange. Without attempting to detail its construction, we may briefly describe the main features attained by this invention which are, *first*, rapid indication of stock quotations; *second*, instantaneous readjustment of the printing in the event of displacement; *third*, correct time; *fourth*, call-bell to main office.



KNUDSON'S NEW PRINTING TELEGRAPH.

First; rapidity.—This is attained by improvements in the machine controlling the type-wheel, and renders it possible by the new instrument to transmit stock sales, and keep up with the most active market. A speed of 130 revolutions per minute has been attained with a number of instruments in circuit, but in practice, 120 revolutions per minute will be about its average, this being about double the speed of the instruments now in use.

Second; adjustment of the type-wheel.—This is effected by the clock to which it is attached, so that if the type-wheel of an instrument is accidentally thrown out of unison with others on the same circuit, it will fly to the zero or unison point during the first pause in the action of the transmitter. This movement being entirely automatic and independent of the central station, such instruments as are out of unison are "set," leaving others undisturbed.

Third; correct time.—This is given by a clock movement of the best make having a compensating balance, which, as is shown in cut, forms part of the instrument. But the movement, though reliable, is not alone depended upon for the correct time. It is so connected electrically with a regulator at the Stock Exchange or Central Station, that, at intervals during the day it will be corrected or brought to syncronism with all other clocks on the circuit. By this means a constantly correct time is maintained at all offices connected by this system.

Fourth; messenger call.—This feature of the instrument, indispensable to business offices, is provided by a mechanism hidden in the pedestal and controlled by a crank on the outside. Besides being a messenger call, its more valuable use is to notify the Central Office in case the indicator becomes seriously deranged, and call an inspector to adjust it, thereby avoiding the expense of time involved by sending a clerk to report the instrument, and also providing for its quick restoration to working order.

These features, while combined in one instrument, operate without conflicting, and taken together, make a complete combination, whereby market quotations are rapidly and accurately given, standard time indicated, and messenger call furnished. Great economy is claimed in the use of this instrument over any yet invented for the purposes indicated.

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transmission of a telegraphic dispatch in Morse signals, and of a telephonic message by one and the same wire.

We shall, in this article, confine ourselves to an explanation of the principles involved in the method, by means of which Mr. Van Rysselberghe obtains the first result, that is to say, the suppression of the induction currents, and we may, in a future number, explain his system of double transmission.

We have said that Mr. Van Rysselberghe, in order to suppress the effects of induction successfully, turned his attention to their origin. To understand how he has accomplished his object, let us consider what occurs in the most simple case (figure 1), that of a telegraph and a telephone line running parallel, and the ends of the wires making earth connections; that is to say, constructed on the same plan as all the telegraphs known.

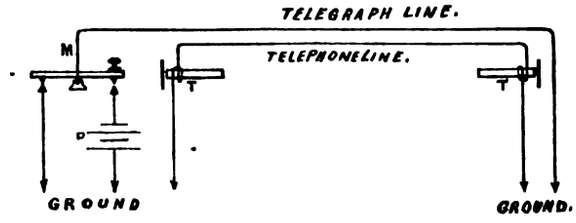

FIG. 1.—PLAN OF A TELEGRAPH LINE AND A TELEPHONE LINE, SHOWING THE CAUSE OF THE INDUCTION EFFECT.

Each time that the key M is pressed, and a current is sent through the line, the wire becomes almost instantaneously charged, every neighboring wire, and in this case the telephone wire in particular, is traversed by an induction current, intense, but of short duration. The same phenomenon is reproduced, but the induction current is reversed in direction when the pressure on the key is relieved, or in other words, when the telegraph current is broken. This succession of intense induction currents of short duration, produces in the telephones a sort of crackling sound, like that of a frying pan, as much more annoying as the telegraph lines are more numerous, and in some cases rendering it impossible to distinguish the telephonic dispatches. Suppose now that by any process whatever the inducing current could be graduated so that it would, not instantly, but progressively, attain its full intensity, the induced currents developed in the telephone circuit would last longer, but would be less intense, and the action upon the diaphragm of the receiver would be also progressive and produce no perceptible sound. In fact an instantaneous and violent attraction would be replaced by a series of feeble, successive impulses.

An idea of the result thus secured can be obtained by comparing it with the effect produced by an air chamber in a hydraulic conduit, or with a common trick of the traveling mounte-bank, based upon the principle of inertia, in which a heavy paving stone, resting upon his abdomen, is broken by powerful blows from a heavy hammer.

To deaden the electric induction pulsations and suppress the crackling or rattling noise, that the unresisted impulses produce, Mr. Van Rysselberghe employs various means. The two following have given him good results. One of them consists in the employment of keys, provided with rheostats, arranged in such a way that when the lever of the key is depressed, resistances, varying from infinity to zero, will be inserted between the battery and the line. These rheostats are formed of substances of medium conductivity, upon which is pressed a brush, attached to the lever of the key. The line then becomes slowly and progressively charged, since the intensity of the current varies with the resistance interposed during the pressing downward of the key, and the effects of induction are no longer sufficiently intense to interfere with telephonic transmission. Telephonic transmission through a distinct circuit is then perfectly practicable, either by means of magnetic telephones, voltaic current telephones, or microphonic transmitters.

A second means employed by Mr. Rysselberghe accomplishes the suppression of the frying, without any alteration in the construction of the key, by leading a derivation from the line through a condenser (*c*, fig. 2).

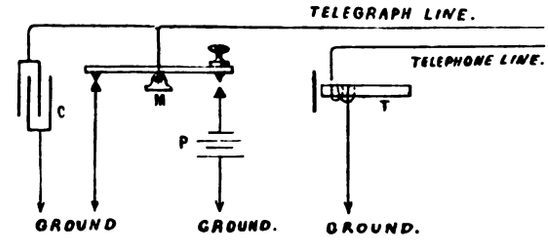

FIG. 2.—PLAN OF A TELEGRAPH LINE WITH A CONDENSER IN A DERIVED CIRCUIT, TO PREVENT THE EFFECTS OF INDUCTION OR "FRYING" IN THE TELEPHONE LINE.

At the moment of closing the circuit, the surge of electricity divides between the condenser and the line, and the latter being then only progressively charged, the desired result is thus, in a measure, obtained. But by combining the two devices, that is to say, by employing both a resistance key and a derivation condenser, the annoying "frying" is completely prevented, and it is this combination which in practice gives the best result.

It is owing to this complete suppression of the effects of induction produced by currents from the Morse key that Mr. Van Rysselberghe has been able to combine the two apparatuses, and use one and the same wire for the simultaneous transmission of a telephonic message and a Morse dispatch.

By considering, in connection with these new results, certain other improvements in telephonic transmitters and receivers, due to Mr. Van Rysselberghe, some idea may be formed of the importance and interest of the labors of the young assistant director of the Brussels Observatory.

—— THE *Evening Telegram* says: The several explosions that have taken place in the public sewers have been caused by illuminating gas that has found its way into sewers by defective gas-pipes and not from sewer gas, the latter being non-explosive.

—— A DISPATCH from Paris, to the London *Standard*, July 12th, says, that an explosion occurred to-day in the Rue Louis Philippe. It was the result of a fire, nobody having thought at the outbreak of the fire to cut off the gas Twelve houses were destroyed. Twenty persons were killed and forty injured. One hundred are rendered homeless.

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IMPROVED STRIKING MECHANISM FOR BELLS.

THE main points of superiority possessed by the striking mechanism, which we illustrate, consists in the form of the hammer, and the position in which it is held at rest.

The hammer is made in the form of a segment of a ring, which admits of a long stroke, combined with compact construction; the movement of the hammer is always in one direction, so that there is no loss of power; the position

Fig. 1

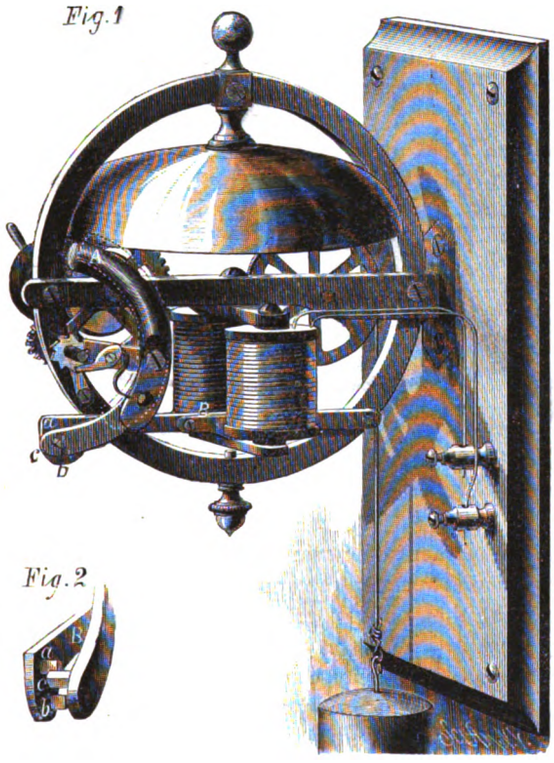

Fig. 2

of the hammer, when at rest, and retained by the stop-motion, is such, that it nearly counter balances the driving power, so that but a very slight magnetic, or other force, is required to operate the stop-motion or escapement.

The engraving represents an electric gong, embodying these improvements, which were recently patented by Geo. E. Bowers, of Fitchburg, Mass.

ELECTRICAL INVENTIONS AND PATENTS.

WE are indebted to the *Quarterly Circular of information and advice about Patents and Inventions*" for June, published by Messrs. Burke, Fraser & Connett, of this city, for use of their clients, for the suggestive article we subjoin on the above subject.

There has been a marked increase during recent years in the number of applications for patents on electrical inventions, plainly indicative of the increasing importance of this field of invention. The wonderful powers and capabilities of electricity have only recently attained any considerable popular recognition, the growth of general confidence in it having kept pace only with the increase in the number and success of its practical applications. Ten years ago telegraphy and electro-plating were the only important uses of electricity; since then the telephone has sprung into being, the electric light has developed into a practical success, and the electric transmission of power has assumed tangible form. These results are almost entirely due to the cumulative labors of many inventors, of whom more are engaged in this promising field to-day than ever before. Each scientific discovery opens up a vista of valuable and practical inventions, each fundamental invention paves the way for numerous improvements, each real improvement adds its weight to the momentum with which electricity is forcing itself as a vital agent into the life of civilization.

This fecundity of invention, this intense strife after new and valuable developments, is largely attributable to the stimulus afforded by the patent systems of all civilized countries, which make it in the interest of an ingenious man to invent and to communicate his inventions to the public. Without patent laws electricity would be to-day about where it was in 1850, perhaps scientifically a little further advanced, but in its practical applications, which make it of real use to the world, no further developed.

The prosecution of applications for electrical patents has become an important part of the business of every successful patent solicitor, and is a department requiring the exercise of the utmost skill and the most careful judgment. In no other field of invention are more intricate and difficult problems in patentability presented; in no other does a slight difference so often determine the practicability of an invention or its advantages over its predecessors; and in no other is it more difficult to formulate claims which shall fully cover the essential feature of novelty in the invention, so as to include all possible modifications of which it may be susceptible, but which shall still distinguish it from what was known before. These difficulties are greatest with United States patents, our law and our Patent Office being more exacting than those of any other country. In the modern practice of requiring exact and definite claims, "functional" claims, so called, are excluded. In many instances it seems almost impossible to cover fully all the possible forms which may be given to an invention without claiming its functions or capabilities rather than its construction. The following is a good example of a functional claim:

A switch *adapted* to form a support for a telephone, and *operated* by the weight of the telephone to throw the latter out of circuit, but *capable*, when the telephone is removed, of two further movements, by one of which a connection may be established between the telephone and the telephones at the stations on one side, while by the other a connection may be established between the telephone and those on the other side.

The italics are our own. This claim was decided by the Commissioner of Patents to be informal, because it was "for the switch having certain capabilities without reference to the mechanism or instrumentalities whereby those capabilities or functions are obtained." To analyse the mechanism of an invention susceptible of considerable modification, to separate its essential from its non-essential features, and to formulate a definition of the novelty of the invention by a recitation of such essentials, which is what is done in every properly drawn claim, is a far more difficult task than to write a recitation of what the invention is designed to accomplish, which is all that a functional claim embodies.

The questions of patentability which arise in electrical cases frequently involve problems requiring for their solution an extended acquaintance with electrical science. Such questions are most often as to whether a certain change or improvement constitutes an invention or discovery, or is merely such as a skilled and intelligent electrician would naturally resort to without the exercise of his inventive faculty; and whether one device in question

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is merely the equivalent of another previously invented, or is sufficiently different to constitute an improvement worthy of a patent.

As an instance of the former question we may cite the case of an electro-magnet of peculiar construction, invented several years before telephones were thought of, which a later inventor applied as the magnet of a telephone, and which produced a telephone having decided advantages over those using the ordinary magnet. The rejection of the telephone application on reference to the electro-magnet patent necessitated an analysis of the source of the advantage resulting from the use of this magnet in a telephone, and a comparison therewith of the advantage of its previous use as an electro-magnet, and it was found that its advantages for both purposes were identical, and hence the subsequent inventor had done nothing more than to substitute one old form of magnet in place of another in a telephone, without the production of any intrinsically new result. Consequently his patent was refused.

Another instance will well illustrate how small an apparent difference may confer patentability on an invention. The applicant claimed the means of regulating an electric light circuit shown in the diagram, Fig. 1, and was rejected on an old English patent which describes the arrangement shown in Fig 2. For simplicity we have made both diagrams alike in all non-essential respects. *G* is an electric current generator feeding a conductor *C*, from which lead several branches, *B*, but one of which is shown. Each branch *B* supplies a number of electric lamps, *l l*,

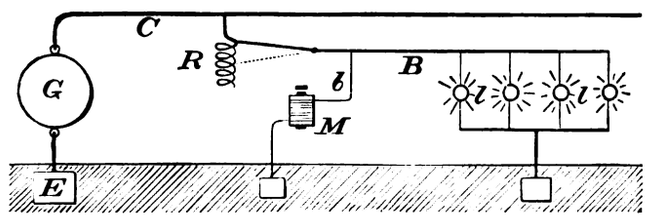

FIG. 1.—THE APPLICANT'S INVENTION.

installed in multiple arc, and at its junction with the conductor *C* is interposed a rheostat *R*, so that by introducing more or fewer of its resistance coils into the branch *B*, more or less potential can be excluded from the branch, according to the varying demand caused by the use of a greater or less number of lamps. This rheostat is operated automatically by an electro-magnet *M*, which in Fig. 1 is of high resistance and arranged in a sub-branch *b*, while in Fig. 2 it is of low resistance and in the main branch *B*. This is the only difference, and at first sight it seems immaterial. This ground was first taken by the Patent Office, but it was urged on behalf of the applicant that there is a broad difference in result. When all the lamps are ignited, thereby affording several paths for the escape of potential to earth, the magnet in Fig. 1 receives its minimum current, while that in Fig. 2 receives its maximum. In both cases the magnets should be so connected with the rheostat that when the potential in *C* is at its minimum, all the rheostat coils will be shunted out of *B*, thereby admitting the potential freely to the branch *B*. But if the potential rises in *B*, consequent upon a rise in *C* or upon an increase of resistance *l l*, caused by extinguishing one or more lamps, as many rheostat coils as are necessary to neutralize this rise should be shunted into *B*. This result the arrangement in Fig. 1 will accomplish, to whichever cause the rise of potential is due, while that in Fig. 2 will attain it only in case the rise is caused by an increase of potential in *C*, whereas the cutting out of certain lamps *l l*, will cause a decrease of resistance at *R*, and admit more potential to *B*. Hence the extinguishing of part of the lamps in Fig. 1 will not affect the remaining ones, while in Fig. 2 it will cause the remaining ones to burn brighter than if no regulator were used. The difference is that in Fig. 1 the *potential* is made uniform, while in Fig. 2 the tendency is to preserve a uniform *current*. On these distinctions being pointed out the patent was allowed.

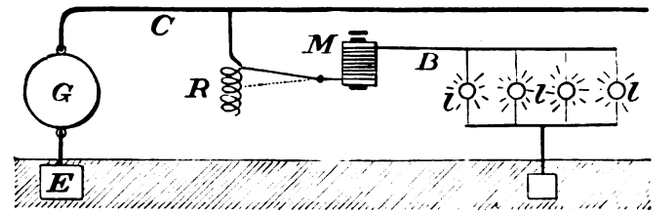

FIG. 2.—THE REFERENCE.

We have cited this case because of its simplicity and the ease of its illustration, not because it is a thoroughly typical example of the class of cases to which we allude, as in many instances the problems involved are far more intricate and difficult of solution than this. In complicated electro-mechanical devices, such as printing and multiplex telegraphs and electrical indicators, the many inter-operating mechanical parts add their complications to those of the electrical features, frequently necessitating the most intense study in their analysis and comparison. It is obvious that the prosecution of such applications should be intrusted only to those solicitors who have the requisite familiarity with electricity as a science, and with electrical inventions, to render them competent to grapple with the difficulties presented.

ELEVATED WIREWAY.

IT is well known, to all interested in the erection of telegraph lines, that one of the most important questions of the day, is, how to properly dispose of the vast number of wires that now crowd our housetops, and cause so much annoyance to all parties concerned.

The proposition to place them underground, does not meet with much favor. It is true that Mr. Edison is burying his conductors, and with apparent success so far; but as he connects his lamps up in multiple arc, he uses only two conductors to serve a large territory, and therefore the question is much more simple in his case, than where a large number of wires have to be buried in a small compass, and thoroughly insulated from each other.

The telephone companies have attempted to simplify the housetop system somewhat, by using cables in some places, but this plan is open to several objections. Conductors cannot readily be led out of a cable with safety, except at its ends, and the troubles from induction in cables are not yet entirely overcome.

A new plan to settle the vexed question, has been lately brought forward, that claims to combine the advantages of housetop wires and trunk line cables, without the disadvantages of either. It is called Scott's Elevated Wireway, and the patent is owned by Eugene F. Phillips, a well known manufacturer at Providence, R. I.

It consists of a system of housetop cupolas, one on each block, connected with each other by rigid or flexible waterproof tubes, through which, common paraffined office wire (say number 18 or 20) can be drawn at will.

Each cupola has a tube, connecting it with each of its four neighboring cupolas. Every block is thus connected with the neighboring blocks, and through them, with every other block in the system, and a wire can be run from any cupola to any other, without leaving the tubes.

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The wires coming into the cupolas from the tubes, are led to cheap connecting screws, where they are connected with those going out through the other tubes. Any wire can, therefore, be interchanged or "patched," if it is found faulty in any section. Wherever a tube crosses a street, it is supported by a strong wire that will prevent it sagging. The tubes can be safely stowed away on the housetops, without interfering with the comfort of the tenants, and will not be nearly so much in the way as the wires now are.

The paraffined wires may be drawn through the tubes from one cupola to another, either singly, or in groups of 10 or more at a time, as may be most convenient. Wires lying loosely in this way are affected less by induction; than when they all run exactly parallel, as in a cable.

In establishing a new line in a system of this kind, the wire is led from its starting point, through the various tubes and cupolas, in the most convenient direction, till it reaches the cupola of the block where it terminates; it is then led from its connecting screw, out at the top of the cupola, through an insulated block, and thence to the roof of the building it must enter.

It will be seen that in this connection, the roofs are used in the ordinary way to distribute the short ends of the lines entering each block; but as these short ends do not cross any street, this will not be objectionable. Besides, in any other system that may be used, the end of each line will probably have to be disposed of in this way.

Each cupola and tube is numbered, and every wire in each cupola is also numbered, so that any line can be traced without trouble or delay.

In case of a fire, temporary cables can be run in place of any tube that is injured, and the latter can be replaced at leisure.

When any tube becomes too crowded, others can be laid alongside of it, as required.

It is apparent that this system is much more economical than any underground arrangement would be, and that it can be erected and maintained with much less annoyance to the public.

From the report of the Sub-Committee on Underground Telegraphy in Cities, dated May 3d, 1882, we make the following extract:

It is contained in the evidence of Mr. Henry W. Pope, a well known telegraphic expert, who has been General Superintendent of the Metropolitan Telephone and Telegraph Co., and of the American District Telegraph Co., and who, therefore, has had great experience in the matter of running telegraph wires in cities.

"It cannot be argued, because the wires of London and Paris are beneath the surface, that those in New York can be similarly accommodated.

"The circumstances are entirely different. Even at this early date, their multiplicity in the sewers of Paris is considered a nuisance, and their rapid accumulation, consequent upon the growth of the telephone business, will eventually necessitate some important change in their present underground system.

"We have seen an elevated railroad system adopted, and constructed in preference to all other plans suggested, because of the similar advantages it has over either under-underground or viaduct roads, that the ærial has over the underground telegraph system, and because capital could not at the time be enlisted in an enterprise so fraught with difficulties.

"With the exception perhaps of the Scott-ærial system, none of the elevated wireways patented or suggested, seem to contain all the advantages necessary; with a light and ornamental support, and their construction confined to a reasonable number of streets, the requirements of the companies would be provided for, and the introduction of subterranean wires obviated to a great extent. The Scott system is particularly useful in combination with an underground system, as a means of distributing wires. * * * * *

"There are many features that will strongly recommend it to those considering the feasibility of massing a large number of wires. One of the most prominent of which, is the fact, that from 150 to 200 wires can be placed in a three inch tube, the number being limited only by the diameter of the wires and size of the tube. Another feature of value, is the fact, that any kind of insulated wire can be used, as the tube between the cupolas being thoroughly protected from the weather, and absolutely dry inside, any style of a wire that will answer inside of a building, will serve the purpose of a conductor equally well. In the process of drawing in the conductors, they become more or less mixed up, their parallelism destroyed, which helps to destroy the inductive effect. The conductors can readily be cross-connected at the cupolas if desired, for the same purpose."

LIGHTING BY GAS AND ELECTRICITY.

CERTAIN of the gas companies of Paris have realized the advantages derived from electric lighting, and have established in Paris, a laboratory, where they can, for their own information, determine by experimental examination, the value of the different systems of electric lighting so far proposed.

To Mr. Ellissen is due this conceit, the happy consequences of which must be evident. Gas and electricity cannot forever preserve the relation of brother enemies, for, as their interests are closely allied, a prolonged continuance of such a relation must be equally pernicious to both.

Without enlarging upon the practical considerations which justify the centralization in the same hands of the promotion of both systems of lighting, we notice a first endeavor toward this object, made at the gas works in Amsterdam.

The problem originated and was determined under some conditions which merit attention.

It was naturally proposed to use a gas engine to drive a dynamo-electric machine, and probably because it was handy, they applied a single cylinder 20-horse power engine to the purpose of igniting 48 Maxim incandescent lamps. Incandescent lamps of course require force, but in this case, the necessary quantity was greatly exceeded. But the engine produced in the lamps a *rythmic* variation in intensity, corresponding to the periods of renewed application of force to the piston in the cylinder of the engine, and sufficient to determine the condemnation of the lamps if it were a difficulty impossible to obviate.

The interposition of accumulators between the electric generator and the lamps, rendered it possible to confer upon the latter the virtue of perfect steadiness

They employed Kabath's honey-comb plate accumulator. The 48 Maxim lamps were connected upon a derivation from the armature of a generator excited by a distinct small machine; 36 accumulators were mounted in such a way that the current from the machine divided between them and the lamps.

They served at once as a regulator of, and reservoir for, the current, regulating the current and storing up its excess.

The 48 lamps were distributed in various offices in the following manner:

General office,	20
Director's office,	9
Engineer's office,	8
Machine room,	3
Purifying room,	4
Offices of night service,	4

The introduction of the accumulators rendered it necessary to keep the engine constantly at work. At 9 P. M. it was stopped, and the 4 lamps in the night offices were then run by the storage battery only. The cost of this method was not examined into, because it was only an experiment to determine the advantages or imperfections of the system.—*Revue Industrielle.*

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THE INTRODUCTION OF GAS.

THE fact that the distillation of wood and coal produces luminous gas, was known from a very early age, but it was left for this century to bring it to practical use as a household and industrial necessity.

The earliest authentic mention of this carbureted hydrogen gas, is the experiment of Dr. John Clayton, a chemist in England, who in 1691 gave an exhibition to some of his scientific friends by heating coal in a retort and collecting the gas in a bladder and then igniting it after puncturing the membrane with pin holes. No suggestion as to its practical use seemed to have been in the minds of either Clayton or his friends, nor does it appear that any of them considered it either new or wonderful, but only curious. It finds a place in history merely as the first mention made of an already well known fact in physics.

Several minor experiments in gas manufacture are mentioned later on, but it is not until 1792, a hundred years after Clayton's experiment, that Mr. William Murdoch, a Scotchman, residing in Cornwall, comes to the front as the real promoter of the gas industry. Murdoch after illuminating his factory at Redruth with gas made from coal, interested others in it, and in 1802 obtained a contract from Boulton, Watt & Co. to light their works in Soho. A year or two later, Murdoch gave the first public exhibition of gas lighting, when the whole front of the Soho manufactory was covered with gas jets in various curious devices, and the *tout ensemble* is said to have been very effective. Probably no such exhibition has ever been given since; the streets of London were thronged with admiring thousands until long after midnight, a thing unknown in those days of dingy oil lamps and deadly assaults. In 1808 Murdoch received the Gold Medal of the Royal Society as the reward for his ingenuity. In 1799 another candidate appears in the field, one Ph. Lebon, of Paris, who lighted his residence with gas made from distilled wood. It seems that neither Murdoch nor Lebon knew of each others invention, for the latter obtained a patent from the French Government for his method and machine for producing gas. In 1804 an enterprising German by the name of F. A. Winsor, visited Paris in the hopes of obtaining Lebon's secret which had been guarded very closely, but failing in this, he set about by his own wits and discovered the methods necessary to produce the desired result. Thereupon he went to England and commenced a series of lectures before the scientists on his improvements in gas lighting. Owing to Winsor's slight knowledge of the English language he had to employ some one to read his lecture, and the consequence was that many tricks were played on the luckless German. At one time his notes were stolen, and at another his hired talker went off on a spree. He persevered however, and finally obtained a select body of adherents, and formed a company for the purpose of lighting London by gas, called the National Light and Heat Company. It seems that all this time Murdoch had been working in a quiet way, and as soon as Winsor drew to himself a goodly company of capitalists, Murdoch sought men of influence to help him contest the case on the ground of priority.

Winsor had commenced his manufacturing efforts and called several witnesses to prove that his coke was much superior to any before made. Hence, by analogy, was argued the efficacy and superiority of his gas, over all competitors. Among the objections urged during the examination, was the inadvisability of placing the gas pipes near wood work, and it was even proposed that a law should be passed compelling the several companies to place the conducts six inches from any wall. Among those who testified on the Murdoch side, was no less a personage than Mr. (later Sir) Humphrey Davy. But he, it seems, was not in favor of the new illuminator, and joined with the scientific authorities of the day in ridiculing the scheme, stated that "it would be as easy to bring down a bit of the moon to light London as to succeed in doing so with gas" he wanted to know if it was intended to commit the sacrilege of turning St. Paul's dome into a gas chandelier, an unheard of presumption indeed! this was then, evidently considered by many as an unholy desecration, however laughable it may appear to us now.

Several constables were called to testify that depredations by night had decreased considerably in number in the district lighted by Murdoch's gas. After this prolonged contest was adjusted, the formation of new companies was kept up until in 1820 the use of gas had become quite general all over the kingdom and on the continent. Besides the difficulties arising out of rival claimants and their respective methods of manufacture there were other and greater obstacles to contend with, viz., mechanical ones. The present gas is as much superior to the first product as the latter was to a rush light. There was in the beginning no way of purifying the gas, but it was conveyed in pipes immediately to the factory or dwelling, and fresh from the retort with all its impurities of odor, and ladened with substances that emitted a thick smoke and noxious smell that was injurious to any fine fabric, to say nothing of a delicately organized being. As long as these disadvantages existed, it could not expect to have a

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general introduction into houses, at least as long as the owners cared for the preservation of their upholstery, wearing apparel, or tapestry hangings, and paint, not to mention their lives. Another thing did not seem to exist, viz., storage retorts; they were even opposed on the grounds of liability to explosion, so that the gas manufacturer labored under the necessity of keeping his pipes constantly filled from a steady coal-consuming retort. This implied, either a surplusage of gas and a consequent waste, or, on the other hand, an insufficient supply. It was not until 1830 that these necessary improvements were fully introduced, and gas of a pure and good quality was supplied from storage tanks, or gasometers, and even now there is room for improvement. The last public place in London that adopted the gas-light was Grosvenor Square, and it was not until 1842 that the oil lamp disappeared from that part of the city. Gas was not introduced in America until 1821, when it had already gained considerable ground in England and on the continent. Baltimore was the first city to use it. Boston followed in 1822, and New York in 1823. It was not until 1827 that it found favor in the United States, and it was many years after this date before it was adopted for lighting the streets.

It is not possible in the limits of a newspaper article to give a complete and succinct history of the early introduction of gas, but enough has been written to show, that the difficulties the Electric Light has to deal with in our day, are few and trifling compared to those of the first gas agitators. Dangers from explosion, fire, and loss of life, were much more common in ante-electric days than since the influence of our modern illuminator has made itself felt. Hence, it is vain and futile for the gas men to try and fight a foe so powerful against their interests as Electricity, and especially, with such incapable and puerile weapons as ridicule, sarcasm and falsehood.

The question naturally arises in the mind of the thoughtful capitalist, who has largely invested in gas-stocks, what then is to be the ultimate fate of gas, if electric lighting becomes general. The answer stands ready at hand. The companies have already begun to see the outlet for their commodity—it is to be the fuel of the future. When all the skill and energy is directed to this great necessity for clean and economical fuel—that is now spent in fighting an enemy that cannot be stowed away, although its last triumph is storage—then the gas companies will find their natural market, and leave lighting of this and every other city for the Electric force.

In conclusion, we may be permitted to quote from a recent able article in Blackwood's Magazine, which refers to the subject, as follows:

"No doubt many will say, and many do say, that the electrical world has got excited, and is promising too much; that insuperable difficulties will come in the way; that when the temporary excitement is over, electricity will not be found to be so much more advantageous than other forces after all; in short, there is plenty of pointing at cold water, and a good deal of throwing of it. It is not much more than sixty years since the most learned men of the day gave evidence on the subject of gas which to us now seems almost comic. The Royal Society reported, in 1814, that no gasometer larger than 6,000 feet capacity should be permitted. Such men as Sir Humphrey Davy and Sir William Congreve, gave evidence before a Select Committee that gasometers of 20,000 feet capacity were too large for safety; that they could not understand the 'temerity' of the Parisians, who were then building one of 300,000 feet capacity—Sir Humphrey declaring that 12,000 was his limit, and that he would be uneasy if he lived near one of 20,000. Great fear was also expressed that if a street lamp went out, the wind might blow down the burner and cause an explosion in the main!

"When Ronalds, about the year 1817, laid his plans for an electric telegraph before the Government, they would not even take the trouble to investigate the matter. An under-secretary, in the usual official style, informed him that he was 'directed by his Majesty's Secretary of State, etc., etc., to inform Mr. Ronalds that a telegraph is of no use in time of peace, and that in time of war the semaphore, then in use, was quite sufficient for the purpose.' In 1879, scientific men declared it would be found impossible to adapt electric lighting to dwelling-houses or small rooms But perhaps there is no instance so remarkable of this want of foresight and practical grasp which is often displayed by the most able and learned men, than what was said about gas-light when it was first introduced, particularly as what was then said of gas is almost word for word the same kind of thing as some are now saying of electric lighting. In 1819, Desormes wrote of gas:

"'The light is of a disagreeable color, entirely different from the red and warm gleam of our oil-lamps. It is of a dazzling brightness; its distribution will be impossible and irregular; and it will be much dearer than oil-lighting; and even if it should be improved, it will still remain much dearer than those lights which we already possess.'

"Substituting the word 'gas' for 'oil,' and reading the passage as if electricity were being spoken of instead of gas, the kind of criticism which is now being made on the electric light is exactly reproduced—'cold, dazzling, impossible to distribute it, irregular, dear.'"

THE agreeable change that the electric light has already effected in the lower part of the city, at night, is very evident. Along Broadway, South of 14th Street, the busy hum of day has gone, and the total absence of retail stores would render it a most gloomy promenade, were it not that the liberal use of the electric light has given a new coloring to everything. Passing into Washington Square—the only park in the city that possesses a few full grown trees—the beautiful and cheering effect of the light becomes more apparent. The grass plots seem bathed in a peculiar soft solar light, and each blade of grass comes out in its natural color. We may yet have in our parks something similar to the scenes observed in the "Land of the Midnight Sun," where the "night only draws a thin veil o'er the day," and the birds go to rest, not because it becomes night, but because they require repose. This light of the future will do much to prevent every species of nocturnal crime, and this is equivalent to saying that many "professionals" will find their occupation gone.

The electric lamps in the public streets and parks, south of 14th Street, have been put up by "The United States Illuminating Company." The lamps and machines themselves have been manufactured by the "U. S. Electric Lighting Co.," under the Maxim, Weston and Farmer patents. The steadiness and softness of the light can be appreciated along Fifth Avenue, Broadway, and in City Hall, Battery, and Washington Parks, which are lighted under a contract with the city government. The progress made in this direction has been very marked, not less than 160 miles of

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circuit wire for arc lights having been supplied by this company since February 1. Three large stations, aggregating 2,500 horse-power, are building and will be completed before October 1. The work is of the most solid character, the engines, shafting, pulleys, &c., being laid on the ground floor, thus avoiding all vibration.

While the success of electric lighting for public use has thus been proved by this corporation, its incandescent lights have given equal satisfaction when used in private buildings. The safe deposit vaults of the National Park Bank have lately been provided with the incandescent lamps, the current being furnished from a central station. The light here is peculiarly soft, yet brilliant, and giving little heat. The air is consequently not only pure, but cool, as compared to that in rooms where gas is used. The contract for supplying light to the bank was to be fulfilled on July 15, but the work was completed two days before that time, although the company suffered under many drawbacks, such as want of stations, &c. The fact proves, however, that the uncertainties which have attended electric lighting are rapidly becoming things of the past, at least in the case of companies provided with the best systems of lighting and conducted with business energy.

THE TRANSPORT OF FORCE TO A DISTANCE.

THERE are two important problems, which, aside from the storage of electricity, absorb the present attention of electrical engineers, and these are, the transport of force to a distance, and the distribution of electricity, or more exactly, of *electric energy* to private buildings.

Let us devote ourselves to a brief study of the first of these problems—the transport of force to a distance.

Considered in its broadest aspect, this problem has been under the consideration of scientists for a long time, and several proposed ways of solving it have been, more or less, practically successful. The driving belts and shafts, which actuate the machinery of a great factory, are but contrivances for the direct transmission of force to a distance, and in a sense, even realize a *distribution* of force, produced by a steam engine or water wheel. In other ways, this distribution is accomplished indirectly, either steam, compressed air, or water under pressure, having been in certain cases specially applicable, and having furnished interesting and useful solutions of the problem.

The idea of conveying power by steam, transmitted through a system of pipes, is now being realized in New York, and any other example would be superfluous. The drills used in piercing the St. Gothard tunnel, were operated by compressed air, and offer a remarkable example of its successful use, and at the Ports of Antwerp and Marseilles, the derricks on the docks are worked by means of water under pressure.

A still less direct solution is afforded by the application of illuminating gas. Gas engines, which are to-day becoming rapidly more perfect, are nothing but devices to convert into labor, force transported to a distance, in the form of a substance, which will, if preferred, furnish it in the other forms of heat or light. In this variety of applications, gas can be considered as having great advantages over its rivals, for neither water under pressure, compressed air, or steam, is so variously applicable.

But to-day, gas meets with a competent antagonist, in the form of electricity, which steps into the ranks of its predecessors, inasmuch, as it aspires to the same applications, and it may be safely asserted that the future will be all its own. For electricity not only combines in itself all the capabilities of water under pressure, compressed air, and steam, without involving their inconveniences, but it also possesses, in a measure, all the elasticity of gas, for it can produce directly *light* and *work*, and under conditions that we proceed directly to examine, even *heat*.

To whom belongs the honor of having first attempted to utilize electricity, for the *transport* of force to a distance? This is a question we can not answer, but whoever can answer it, knows that the idea originated since the invention of the powerful generating machines of Wild, Ladd and Siemens.

When the voltaic battery was the only practicable generator of electricity known, no one thought of its adaptability as a source of force to be transported to a distance, although the telegraph is an instance of its having been unconsciously so employed for a long time, for every movement of the lever of a Morse relay or sounder, converts into mechanical power the electric force, brought by the telegraph wire from a distance, which is produced by the chemical energy developed in the transmitting battery.

The first actual experimental application of the transport of force to a distance, occurred at the Exibition at Vienna (Austria), in 1873. It was accomplished by the Gramme Company, of which Mr. Fontaine was, and is still director. In this experiment a Gramme machine, driven by the general power of the exhibition, produced a current, which, after being carried two hundred metres distant (656 feet), to an annex of the exhibition, was there used to actuate a second Gramme machine (used as a motor), which in its turn worked a rotary pump.

A little while after this experiment, electricity was applied in France in several manufactories, to transport force from a single motor into work-rooms, which were isolated, or placed at distances so great, that power could not be conveniently led to them by belts or rotary shafts, and still later, in 1879, to electric farming or ploughing, and to the propulsion of railroad and tramcars.

A French proverb says, that "*L' appétitit vient en mangeant*," (an appetite comes with eating), and the result of studying this question in all its aspects, is, that an appetite for it has developed among electricians, and even among those who are not electricians, and the result is, that certain projects have been initiated, which exceed in probability all that can reasonably be expected from the transport of force to a distance by means of electricity. To-day, nothing less is proposed than to transport to New York the enormous power represented by the Falls of Niagara; and Mr. Bessemer, in England, proposes to burn all the coal

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now consumed, at the places were it is mined, convert it into electric energy, and transport it in this form to the places where it is now carried in bulk; more especially he applies his proposition to the case of London, and all the coal now consumed in that city he would burn at the mines and transport it virtually to London, a distance of over 120 miles, through a single wire of only an inch in diameter, in the form of electric energy.

This project is very taking to the imagination, but it is a chimerical impossibility that I propose to expose in time, but we must confine ourselves at present to the general conditions under which the transport to a distance, of force, in the form of electric energy, is practicable.

The electric carriage of force to a distance, is founded upon a property of dynamo and magneto-electric machines of continuous-current, that is called reversibility.

This property, or rather principle, of reversibility, which is met with in other instances of physical phenomena, can be thus expressed:

When *labor is expended* to drive a magneto or dynamo-electric machine, it *produces an electric current;* when an *electric current is expended* upon a magneto or dynamo-machine (which is then called an electro-motor), it causes its armature to revolve, and *produces labor.*

This phenomenon is displayed in certain rotary pumps, which, when actuated by a motor, will elevate water, or which turned by a falling stream of water, will drive the motor. The analogy here described, and which is common to a great number of electric and hydraulic phenomena, is very convenient, in that it permits us to somewhat *materialize* electrical phenomena in our minds, and without attaching more importance to it than is warrantable, we can always have recourse to it to simplify certain explanations, and to grasp the theory of certain phenomena, a comprehension of which is facilitated by drawing a comparison with something already familiar.

Let us revert now to the electrical transportation of force in a most simple case, that is to say: a generating machine A, driven by any motor whatever expending a certain quantity of labor, and joined by a conducting wire of a certain length to a receiving motor B, doing a certain amount of work. It is certain that the motor B will not produce as much labor as the machine A expends. It is necessary to allow for the friction, and the heating of both machines, and for the heating of the conductor by which they are united. The relation between the labor received from B and the labor expended by A is called the work rendered, or *duty.*

The labor expended by the machine A being equal in volume to the current it engenders we have its intensity I multiplied by the pressure or electro-motive force that it develops. The labor produced by the machine B is equal in value to the current which traverses it, and is consequently the same as the current traversing it (I), multiplied by the contra electro-motive force it develops (e).

$$\text{Labor expended by A} = E\,I$$
$$\text{“ produced by B} = e\,I$$

The duty is therefore equal to

$$\frac{e\,I}{E\,I} = \frac{e}{E}$$

From this results the apparently incontrovertible consequence that the duty is independent of the resistance of the circuit, that is to say, of the distance of the two machines and of the length and size of the conducting wires which unite them. This is explained when we study the matter more closely. It is seen that the labor produced by the machine B and the labor absorbed by the machine A are proportional to the intensity of the current. But in accordance with the law of Ohm, as applied to the case under consideration:

$$I = \frac{E - e}{R + R_A + R_B}$$

in designating by R the resistance of the conductor, R_A the resistance of the machine A; and R_B the resistance of the machine B, it is evident that if R be augmented we shall diminish the intensity, and consequently the labor, expended by A and the work produced by B without changing the duty.

The resistance of the interposed conductor, that is to say, the distance between the two machines, effects a diminution of the work done and the labor expended respectively by the two machines, without changing the relation of the labor expended to the work received.

From this results an important consequence, which is, that to transport the same quantity of labor to a distance greater and greater in the same time it is necessary to augment the electro-motive force in accelerated ratio, or employ conducting wires of larger and larger diameter in order to avoid increasing the resistance of the interposed circuit. Either of these alternative systems presents inconveniences. Low pressures have the inconvenience of demanding conductors of a cost beyond all proportion to the result obtained. High pressures involve great danger and numerous chances of misfortune if the wires are not perfectly insulated, and carefully placed beyond the reach of ignorant and vicious persons.

Here, then, rests an important practical problem, the solution of which is purely an affair of personal appreciation; what electric pressure or what electro-motive force must be employed in order that the conductors shall not be a permanent source of danger, wherever they may be carried and rapidly multiply?

This question interests at once the electrical engineer, who takes the responsibility of establishing a system, the client who is to make use of the apparatus, and the public officer on whom devolves the responsibility of the public security.

In default of a precise figure officially endorsed, certain accidents, numerous and deplorable, have occurred, which imperatively limit the highest acceptable tension.

A death caused quite recently by a 16 light Brush Machine, the tension of which hardly attained 800 volts, proves that it will be imprudent to greatly exceed this

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figure, especially when the great multiplication of wires, probable to occur in the future, will render almost all precautions inefficient.

If to fix the idea we accept the figure 1,000 as the extreme limit of tension acceptable, we arrive at the following results :

To transport a force of 50 horse-power one hundred kilometres (60 miles), and receive, theoretically, at this distance 40 horse-power, the section of the conductor, if of copper, must be $3\frac{1}{10}$ centimetres (about ¾ inch) square. It must, thererefore, weigh 279,000 kilogrammes (260 tons), and cost nearly a million of francs (200,000 dollars).

It is, therefore, impossible to economically transport 50 horse-power to a distance of 100 kilometres (60 miles), with an electric pressure not exceeding 1,000 volts, and the simple calculation, the results of which we have given, and of which we will furnish the details if the results be questioned, shows that the project of Mr. Maurice Levy, presented by the author to the Academy of Sciences, is absolutely impracticable, if an electric pressure compatible with safety be employed.

Mr. Bessemer originated some time ago a project of electric transportation, not less impracticable, in our judgment, than that of Mr. Levy. He proposes to convey to London a force of 86,000 horse-power by a copper wire, about a pouce (about an inch) in diameter, from a distance of 200 kilometres (120 miles).

Calculation shows that the electric pressure involved must exceed 300,000 volts. How is a conductor traversed by a current of such preposterously high tension to be insulated ? What will be the loss by leakage during its transit ? These are small details which Mr. Bessemer has not touched upon. Perhaps he has overlooked them.

The project was attractive, it came from a prominent authority, it was accepted without question, and it illustrates how the fancy will sometimes mislead the reason.

Turn to either side, and in the present state of our actual knowledge of this subject, we meet with an insurmountable barrier when we aim to effect, electrically, the transport of a great quantity of force to a great distance.

Mr. Marcel Deprez, who has made an extensive series of laboratory experiments upon this problem, has derived from them the following result : He has transmitted a force of a half horse-power (chev. vapeur), through a resistance of 500 ohms, 58 kilometres of iron wire, 4 millimetres in diameter (30 miles of iron wire about ⅛ inch in diameter), with a Gramme Machine, wound with exceedingly fine wire and having a feeble current intensity and an electric pressure or electro-motive force of 2,400 volts. These results were communicated by Mr. Marcel Deprez, to a conference held in the conservatory at Paris, on the 15th of June, 1882, but the author took especial pains to impress the fact that a person would be destroyed as if by lightning, who had the temerity to touch the poles of either the generating or receiving machine.

If we compare these results with the project of Mr. Maurice Levy, we shall see that the electric transport of great power to great distances is restricted, for the present, by two barriers equally insurmountable and these are, the necessary sacrifice of money, or *life*, money for low pressures and large conductors, life for excessive pressures.

Let us have the candor to admit and the good sense to recognize the limits of these alternatives and labor to remedy their inconveniences, by keeping in a middle course, that is to say, by accomplishing the transport of moderate power to moderate distances with a moderate tension.

We shall devote our next article to a consideration of what has been so far done in this direction, and in connection with the subject we will describe some typical machines that have been devised for this especial end.

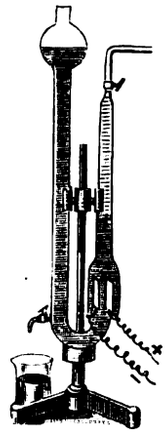
E. HOSPITALIER.

SECONDARY AND STORAGE BATTERIES.

BY PROF. A. K. EATON.

I. THE THEORY.

THE simplest form of a "secondary battery" consists of two plates of platinum (or some other equivalent substance), immersed in acidulated water—as in the ordinary *voltameter*, the latest improved form of which is represented in Fig. 1.* When the poles of a moderately powerful battery are connected with these two plates of platinum the water is decomposed and hydrogen is evolved at the plate connected with the negative pole of the battery, and oxygen from the plate connected with the positive ; (the acid present has nothing to do with the reaction except to make the liquid a good conductor of the current.) The two gases, however, do not wholly pass away, but a portion of each is held to the surface of the platinum, *i.e.*, a film of hydrogen clings to the plate connected with the negative pole, and a film of oxygen to the other plate. Now, if the battery be disconnected, and the two platinum plates, still in the acidulated water, be connected, through a galvanometer, a current will manifest itself of considerable strength, for a short time, in a direction opposite to that which was sent through the apparatus by the battery. This is owing to the re-combination of the oxygen and hydrogen that accumulated upon the platinum plates during the action of the battery. This involves the whole theory of the secondary battery, but the amount of current to be thus obtained is so limited that practically it is of no special value. The amount of oxygen and hydrogen thus "stored" upon the surfaces of the platinum is of course very small and productive of correspondingly diminutive reaction. The necessity therefore arises, of accumulating oxygen or hydrogen, or something equivalent, in a *solid* form instead of the gaseous. Let us substitute lead plates for platinum as in the first simple form described, and see in what respect the reactions will be different. The battery being connected, with the two lead plates im-



* Designed by Mr. Levison.

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mersed in acidulated water, hydrogen would pass off from the lead plates connected with the negative pole of the battery without chemical action, but the oxygen developed at the surface of the other plate, combines with the lead to form oxide of lead. Here we have oxygen accumulating in the solid form, and we can avail ourselves of it by the following treatment of the lead plates: Having formed a slight film of oxide by the first charge from the battery, the secondary is discharged by connecting the two plates by means of a short, thick wire. In this act of discharging, the oxide of lead formed on one of the plates, passes over in part to the other plate until the equilibrium is restored between the two, *i.e*, both plates become equally oxidized. The battery is again connected, but with the poles reversed, so that the hydrogen is evolved at the plate previously oxidized. The oxide of the negative end plate is thus reduced and a film of spongy lead is the result, and the oxide of the other plate is raised to its highest point of oxidation. By continued repetitions of this discharge and reversal of the poles, the plates of the secondary finally become, the one covered with a thick, layer of spongy lead, and the other with peroxide of lead. Here we have the desired condition of an accumulation of oxygen in the *solid* form upon one of the plates, and therefore have it stored up in quantity sufficient for practical work. When this form of secondary is in action, there is a gradual transfer of half of the oxygen from the peroxide covered plate to the sponge covered one until equilibrium is restored, and the oxygen assumes the form of a lower oxide of lead distributed alike upon the surface of each of the plates. This is Planté's form of the secondary or storage battery, invented long since, but available only to a limited extent, owing to the long time involved (amounting to weeks and even months), in the many reversals of the battery's primary action. The first successful application of this principle to the storage of electricity was made by M. Faure, and as this is the form hitherto principally used, a description of its construction is in place.

Faure applies to the surfaces of his lead plates a layer of red oxide of lead, held in place by flannel, felt, or other suitable fabric. This red oxide, by the action of the primary battery, is converted, on one plate, to a peroxide of lead, and on the other is reduced to spongy lead, thus reaching the same final results as were obtained by Planté, but in a very short time.

We may say then, in general terms, that a storage battery, when charged, consists of two plates or elements, one of which holds a supply of *solid* oxygen, the other being in such a condition that it will readily absorb oxygen when permitted to do so by connecting the plates by means of a conducting cone or wires.

Any arrangement of two metallic surfaces separated by a fluid, which is a moderately good conductor of electricity, in which one of these surfaces is more highly charged with oxygen than the other, becomes a "secondary battery," by virtue of the tendency of the surplus of oxygen in one of the elements of the combination, to combine with the other element and effect an equilibrium. But only when one of the surfaces become charged with oxygen, chemically combined, does it become a storage battery, properly speaking.

(To be continued.)

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

II. DU FAY'S DISCOVERY OF TWO KINDS OF ELECTRICITY.

TO detail specifically the multitude of observations which followed the experiments of Grey and Wheeler and contributed to the rapid development of early electrical science, would engage us in a labor beyond the limit of our purpose, but the capital events of electrical history must not be ignored, and the next in order of these was the discovery of two kinds of electricity.

The clear perception of Du Fay, a cotemporary of Grey, enabled him between 1733 and 1737, to evolve from the phenomena of his own and his predecessors' experiments, and explicitly state certain of the important natural laws which they revealed. In the first place, he extended the class of substances called electrics, for he demonstrated that any substance whatever, except a metal or a body in a soft or liquid state, could be electrified by friction with any sort of cloth if it were previously warmed. In the second place, he showed that the conducting power of the hempen cord used in the experiments of Grey depended on the moisture contained in it, and was increased by wetting it. This expedient enabled him to transmit electricity along a cord to a distance of about 1,300 feet. In the third place, he showed that almost any substance if supported upon glass, well dried and warmed, could be electrified by contact with an excited electric, such as a glass tube rubbed with a cloth, and that, consequently, this property was much more general than Grey suspected, and further, that if an excited electric were repeatedly applied to such a body supported on glass or silk threads, the repeated charges would be stored up in it until it became quite highly electrified.

It had been previously ascertained that when electricity was communicated by a charged body to another, near, but not in contact with it, the electricity passed in the form of a spark accompanied by a snap or cracking noise, and Grey and Wheeler had discovered that the bodies of men and animals could be electrified by the glass tube like ordinary bodies, if suspended by silk cords to prevent the escape of electricity. So, in the fourth place, Du Fay reasoned that a man being thus suspended by silk cords and electrified, the electricity could not escape, and that sparks of fire should issue from any part of his body and escape to any other suitable object approached near him. To experimentally test this conceit, Du Fay suspended his own body, and being electrified, the Abbe Nollet, who assisted him in these experiments, presented his hand to the person of Du Fay, when immediately a spark of fire issued from the one and entered into the other experimenter. Although

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such a result was predicted, Nollet stated that he could never forget their surprise when the first discharge exploded between them. But Du Fay's celebrity is due, not to his experiments, but to his clear expression of the principles of attraction and repulsion which had been examined by so many previous investigators. I discovered, says he, a very simple principle which accounts for a great part of the irregularities, and if I may use the term, the caprices, that seem to accompany most of the experiments in electricity. This principle, which we stated in our first sketch, almost in his language, was, that excited electrics first attract all bodies; second, that after a body has been thus attracted and touched by the excited electric, it will be repelled; and third, that a body so repelled will not be again attracted, as at first, until it has touched some other body.

But this was by no means so important an announcement as that which followed it, for, continued Du Fay, "chance threw in my way another principle more universal and remarkable than the preceding one, and which casts a new light upon the subject of electricity. This principle is, that there are *two distinct kinds* of electricity, very different from one another; one of which I shall call VITREOUS, and the other RESINOUS electricity. The first, is that of glass, rock crystal, precious stones, hair of animals, wool, and many other bodies; the second, is that of amber, copal, gum-lac, silk thread, paper, and a vast number of other substances. The characteristic of these two electricities is, that they *repel themselves* and *attract each other*. Thus a body of the vitreous electricity repels all other bodies possessed of the vitreous, and, on the contrary, attracts all those of the resinous electricity. The resinous also repels the resinous and attracts the vitreous. From this principle one may easily deduce the explanation of a great number of other phenomena, and it is probable that this truth will lead us to the discovery of many other things."

This was strictly a discovery, not only of a fact, but of a general principle, and its consequences have fully justified Du Fay's anticipation that "it would lead to the discovery of many other things," for, with the assistance of later hypothesis, it has brought the subtle electric influence under the control of mathematical calculation, and is the basis of the only theory of electricity which is to-day sufficient to explain all the phenomena of the science.

Respecting an electrified body, whether electrified by contact with an excited electric, or directly by friction, a new question now arose. To know merely that it was electrified was no longer sufficient. It was required to know with which of the two kinds of electricity it was invested. The test to determine this, proposed by Du Fay, has been adhered to ever since his time.

He electrified with a known species of electricity, say, for example, the resinous, a light object freely suspended. If this object was repelled when brought near another electrified body then the electricity of that body was known to be of the same kind, or resinous, but if, on the contrary, it was attracted, then the electricity of the other body was evidently vitreous. The object we generally use to-day is a pith ball suspended by a silk thread from a glass support, and the mode of using it is shown in Fig. 1.

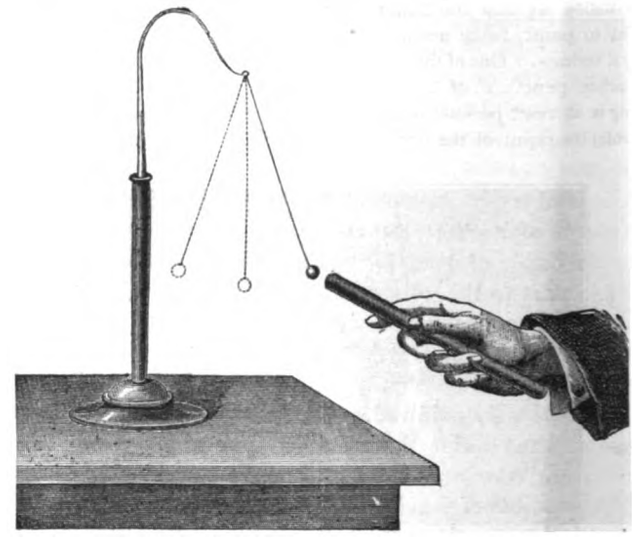

Fig. 1.—A pith ball suspended by a silk thread, and electrified with resinous electricity, is attracted by a glass tube electrified with vitreous electricity.

Dr. Desagulier, a well known physicist, devoted some attention to electricity between the years 1733 and 1742, but he contributed no new facts toward the extension of the science. He, however, first applied the term *conductor*, now so commonly used, to designate a substance capable of freely transmitting electricity.

OUR LONDON CORRESPONDENCE.

LONDON, July 2, 1882.

THE "SUN" ELECTRIC LAMP.

IN my last notes, I mentioned the introduction in England of the comparatively new system of arc incandescent lamp known as "Sun" lamp.

This system is now being exhibited in London, where it is attracting great attention. A public demonstration of it was given in London on the 24th June, before a crowded audience of scientific and industrial gentlemen and representatives of the London press.

The vaults of the Royal Exchange was selected as the most suitable place for exhibiting the light in the city during daytime, darkness being always prevalent in that place.

Two rooms had been fitted up and furnished, one as a reading room, the other as a drawing room. In the first room an inverted lamp, concealed in a basket of flowers, suspended from the roof, was throwing its rays of light on the low roof from which it was reflected downwards, in lighting the whole room with a soft, steady, diffused light. In this room various models of the lamp and its fittings were exhibited and explained, as well as numerous engravings illustrating the lighting of various places abroad by means of this lamp. Models of lamps with marbles cut in various ways, so as to throw the whole power of the lamp in a given direction, where shown (this model is called the "Panorama" type, as it is very suitable for lighting panoramas); another lamp mounted on a pivoting frame illustrated the manner in which the ordinary lamp can be made to throw its light in all the directions of a vertical or an horizontal plane. An automatic re-lighter was also exhibited in the same room and shown in operation in the engine room. We hereby give illustrations of the "Sun" lamp, and if these illustrations are compared to the description which we gave of this lamp in our last notes, the lamp, which is so simple, will be easily understood and its working explained. We also give an illustration of the automatic re-lighter, with which the lamp is relighted by merely reinstating the electric current in the circuit.

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With this arrangement, the carbon pencils, instead of being placed at a slight angle with the vertical, and impinging by means of their own gravitation against the bottom marble, are arranged horizontally and point to point, being made to impinge against the marble by means of spiral springs. One of the carbons is hollow, and in its centre hole travels a carbon pencil, *C*, of a very small diameter, and which, when everything is at rest, presses against (passing through suitable holes in the marble) the point of the opposite carbon pencil, fulfilling the duty of the

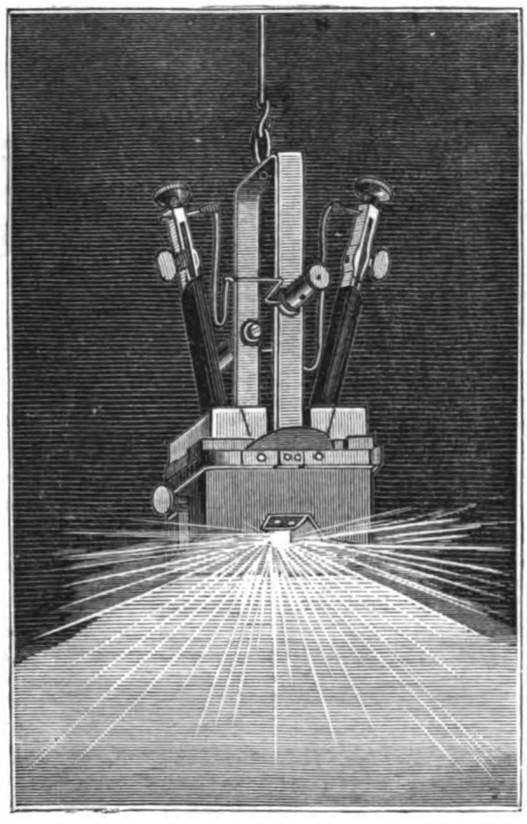

FIG. 1.

wick, or primer, which is necessary for connecting the carbon points at lighting time, in order to kindle the lamp. When the lamp is going to be lighted, the current, circulating in the solenoïd, *S*, attracts this latter's central core, and the lever connected with it, oscillating round its centre, pulls away the small carbon pencil *C*, against the weight of the counterpoise *W*; this has the effect of producing a gap between the two carbon points and the voltaic arc, spread at first between the opposite carbon and the small lighting pencil's point until this point has reached the other carbon's end, at which time the kindling of the lamp is effected. Should the current be interrupted for any cause, the attractive power of the solenoïd ceasing to produce its action, the counterpoise *W* would, by falling, push the small pencil *C* afresh against the opposite point, ready to be withdrawn in the same manner when the current is re-instated.

We also illustrate Mr. Clerc's current indicator, in which *S* is a solenoïd, the core of which is connected with a hand, causes the said hand to travel on a graduated circle indicating the variations of the current according to the changes of positions of the core in its coil. In the event of an accidental extinction, the core, when falling, is made to close the circuit of an electric bell in the engine room. The arrangement of circuit shown in the diagram does not apply to lamps provided with self re-lighters, and two, three, four, or five lamps, *L*, should be shown on each wire, instead of one, according to the size of dynamo-machine used.

The drawing room was most beautifully lighted by means of two lamps, one having a clear glass and the other an opal glass globe; the arrangement being such that the floor was lighted direct from the lamp.

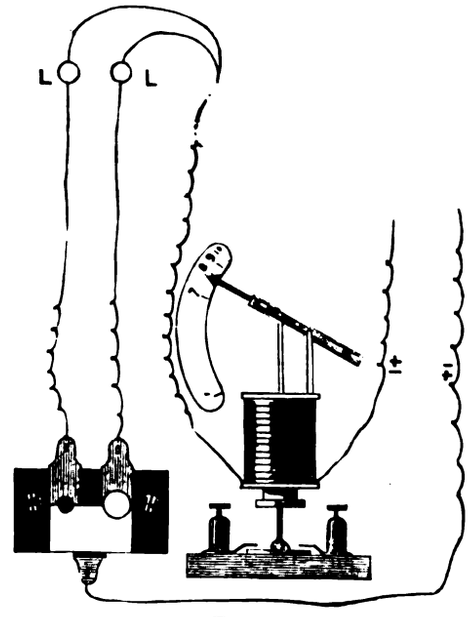

FIG. 3.

The effect of the light on the pictures hung round the room was all that could be desired.

In the engine room a fourth light, burning without a globe, was illuminating the said room and completing this experimental demonstration. The four lights were maintained, in two circuits of two lights each, on a No. 1 Gramme self-exciting, alternating-current machine. Each light was said to be of a candle power of from 1,200 to 1,400 candles. A second Gramme machine, of the same size and description than the first, was driven from the same motor (which was a 12 H. P. "Otto" gas engine—much too powerful for the purpose), and used occasionally for illustrating the working of the self re-lighter, which is of recent invention and has not been applied to the lamps yet. We are indebted, for the two last engravings, to the kindness of the *Electrical Review*.

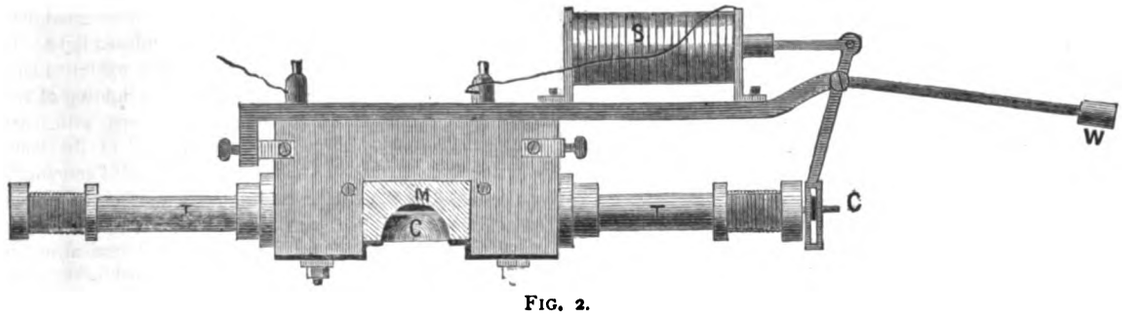

FIG. 2.

ANOTHER SUBMARINE CABLE COMPANY.

A new Submarine Cable Company is at the eve of being floated on the British market. Its name will be the "European, American, Canadian, and Asiatic Cable Company, Limited." The capital is to be £1,500,000 in 150,000 shares of £10 each.

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One feature of this company is, that it proposes to establish telegraphy upon a system of mutual profits, the amount of net earnings on any division of these being made are going to be apportioned as follows: Two-thirds to the shareholders' capital, and the remaining third among original shareholders of not less than ten shares each, or subsequent shareholders of not less than twenty shares each, contributing business to an amount of not less than £20 per annum, such contributing shareholders participating *pro rata* according to the amount of their business.

Another very interesting feature of the said company is, that it has decided upon commencing business at exceptionally low rates, adopting a tariff of 9d. per word between England and New York and Eastern Canada. It is even added that the said tariff will, if necessary or advisable, be reduced to even a lower figure. This looks very promising indeed, and especially at the very moment that the existing cable companies have combined to raise the rate to two shillings per word.

The company will have two separate cables across the Atlantic, thereby rendering it independent of external aid.

The contract has been given to the well-known firm of W. T. Henley's Telegraph Works Company, Limited, who, for the agreed price of £1,443,176, will lay down about 6,120 miles of cables, comprising two complete cables between England and Sable Island, and connections with Canada and the United States.

The insulation will be composed of Henley's Patent Ozokerited core, which is ten times more insulating than the best insulating materials with which other cables are insulated and said to be practically indestructible.

On testing a specimen of the deep sea cable, its breaking strain was found to exceed ten tons, which, the size of cable being taken into account, is about 40 per cent. more than that of other cables of the same weight.

The estimated life of the cable is 20 years.

The contractors accept, out of the contract price as above mentioned, £350,000 in the company's shares in part payment, at the option of the company.

We can only offer our best wishes to a company started on such promising prognostics.

THE CRYSTAL PALACE INTERNATIONAL FIGHT BETWEEN ELECTRIC LIGHT AND GAS LIGHT.

The Crystal Palace Electrical Exhibition was closed the 3d of June, and the enterprising directors of that establishment finding, no doubt, that the game was a good paying one, have lost no time in inviting the none less enterprising firms who are seeking for opportunities of advertising, and do not object to contribute for a season to the free lighting of the Palace, to a new show, which, although the electricians have had, to our knowledge, no direct intimation of what was in store for them, appears to be intended as an arena in which the friendly fight between the gas lighters and the electric lighters will take place, if not to the great interest of science, it is expected to the great advantage of the Crystal Palace exchequer. In a circular, dated Crystal Palace, the 6th June, 1882, and headed Electric Exhibition, 1882, and of which we give a copy hereafter, it is said, amongst other things, that the directors are prepared to organize "another Electric Exhibition." Not a single word is said about organizing, by the side of it, and at the same time a Gas Lighting Exhibition. It has come to our knowledge that it was proposed to hold an exhibition of gas lighting appliances simultaneously with the proposed Electrical Exhibition, and to devote, in competition with each other, one-half of the Palace to each of these two industries. There was evidently some foundation in the rumor, as it is now officially announced that in his proposal, the Manager of the Palace indicates as the reason for holding the exhibition, the lighting by gas, in direct competition with electric lighting, and has already held a preliminary consultation with a few gentlemen known by him to be interested in gas supply; it is added, also, that the result of the said consultation has been an expression of opinion generally favorable to the proposal.

We do not wish to intimate that the authorities of the Palace had any idea of concealing anything to the electricians, as secresy in that case could not have been held for any length of time and it would, therefore, have been a childish policy; it may also be, that the circulars addressed to the electricians reached us, and the one intimating the co-operation of the gas industries, although addressed to us, was misdirected, or got lost somehow or other, for we did not receive any; but what we feel bound to point out is, that the circular which we have alluded to at the beginning of this article, and of which we give a copy in extenso hereafter, is wrongly headed, wrongly written, and certainly misleading. We should propose, for its heading, as well as for the name of the race, fair, show, or fight, (we do not know how really to call it), to which the electricians have been so courteously invited, the title with which we have begun this article. This is only our very humble proposal.

It is announced that an electrical exhibition will take place this autumn at Manchester, and it is rumored that a similar exhibition (?) will also be held, this autumn and winter, at the Westminster Aquarium. What next?

ELECTRIC EXHIBITION, 1882.

To the exhibitors at the recent electric exhibition, and others:

Gentlemen—The recent electric exhibition has been a success in every sense of the word, and many of the exhibitors have urged the directors to keep the exhibition open. It has been necessary, for several reasons, to close it, but the directors, bearing in mind the great interest of all classes of society in electricity, the fact that the movement is in its infancy, the vast amount of capital invested in it, and the strong demands made upon them, are prepared to organize another electric exhibition, to be opened in the autumn.

With this in view, they will allow all the exhibitors at the recent exhibition, to leave their goods at the Palace, at their own risk, but as much care of them will be taken as if they belonged to the company.

The directors embrace this opportunity of bearing willing testimony to the cordial manner in which the exhibitors have co-operated with the directors in making this Grand International Electric Exhibition successful.

I shall be glad if you will let me have an early reply to this, and will favor me with your views on the subject.

I am, gentlemen, yours faithfully,

S. FLOOD PAGE, *Manager.*

CRYSTAL PALACE, 6th June, 1882.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

The 42d number of the Journal of the Society has been published; it contains the following papers and communications:

Description of a form of battery of low internal resistance, by Mr. F. Higgins, member.

Tests of incandescent lamps for fall of resistance, with increase of electro-motive force and ratio of candle power to work done on lamp, by Andrew Jamieson, Esq., (member) A. M. I. C. E., Principal, College of Sciences and Arts, Glasgow.—Discussion on Mr. Jamieson's paper.

On attraction and repulsion due to sonorous vibrations, and a comparison of the phenomena with those of magnetism, by Mr. A. Stroh.—Discussion on Mr. Stroh's paper.

Reports on the incandescent lamps exhibited at the International Exposition of Electricity, Paris, 1881; communicated by Professor W. Crookes, F. R. S.

Shunts, in connection with condensers, by W. F. Nosworthy, (member).

On the working of the Brown-Allan cable relay, by H. C. Mance (member).

The Society has also published the list of its members, corrected to 22d April, 1882.

SUBMARINE TELEGRAPHY.

The third section, 483 nautical miles in length, of the Central and South American Telegraph Company's cable, namely, that from Santa Elena, in Ecuador, to Buenaventura, in the United States of Colombia, has just been completed.

This Company was formed in the latter part of last year, with a capital of $5,000,000, in 50,000 shares of $100 each. The cable was intended to connect Vera Cruz to Lima, passing through Saint Jose, Realejo, Greytown, crossing the Isthmus of Panama, Buenaventura, Santa Elena, Payta; and will complete the system of which the two ends are already established, viz: Vera Cruz to Brownsville, and Lima to Valparaiso;

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Valparaiso will, therefore, when the cable is complete, be in direct telegraphic communication with the United States of America (the frontier telegraphic station of which is Brownsville), and consequently with the rest of the world.

The manufacturers and contractors are the India Rubber, Gutta Percha and Telegraph Works Company, limited.

The cable is composed of a core of 7 strands of copper, weighing 107 lbs. per knot, and covered with gutta percha weighing 140 lbs. per knot (nautical). The gutta percha is surrounded by yawn covered with an envelope of 15 steel wires, No. 13 (B. W. G.), then two layers of tape with compound.

The deep sea cable weighs 1¾ tons per knot; the shore end, 14 tons; and the intermediate part, 4 tons.

The population of the countries traversed by this cable, is 36 millions.

MUSIC ELECTROGRAPH.

A new "Music Electrograph," the invention of Mr. J. Föhr, of Stutgard, was, at the monthly meeting of the Musical Association, held at the beginning of June last, exhibited by Mr. T. Southgate. The apparatus writes down on a band of paper, which is unwound by clockwork from a cylinder, any music played on a pianoforte on which it is attached. This result is obtained by the current staining the paper, which is chemically prepared; the duration of sound being indicated by the lengths of the stains.

COMMUNICATIONS WITH LIGHTSHIPS.

At the same time that Englishmen are holding meetings upon the subject of electric communications with lightships, and telegraph companies are exhibiting inventions designed for the same object, the Secretary of the German Navy has definitely resolved to employ carrier pigeons in the coasting service. This resolution was arrived at after six years of successful experiments. Birds properly trained for the purpose, have flown the distance of 60 miles in 30 minutes during a heavy gale.

J. A. BERLY.

Mr. Editor:

THERE would seem to be but little doubt, from what I have seen in some English papers, and especially in the very interesting correspondence of Mr. Berly, that the English are ahead of us in "speculative" electricity, in other words, in the application of the arts of the sharps of the money market to the purpose of making the science and industry a means of extracting money. This, of course, was to be foreseen, and in fact speculation within proper bounds is exactly what is required.

A report in the London *Electrician* of a general meeting of "The Electric Light and Power Generator Company," which was lately held in London, under the presidency of Admiral Sir Edward Inglefield, contains a resumé of the difficulties raised by other companies, and the subterfuges that are had recourse to. This company, originally formed for working the Lontin lamp, and fifth on the list of electric light companies formed in London, is now owner of the Maxim and Weston patents, and its success has been very satisfactory. The greatest difficulty was found in coming to agreements with storekeepers and others, who actually expected to be paid something in the first place. All this was, of course, owing to underbidding, to a total lack of that reserve which is sometimes as requisite in business as in social life. But, the English companies, it seems, have adopted the principles of the New York lager beer brewers, who, it is known, have to "treat" well before securing a new customer.

Not only this—although electricity is not an article that can be hawked about the streets and branded with a trade mark—yet it would seem that it is not unamenable to the schemes of the aforesaid sharp people. The company in question assumed a rather too general name, and they were soon convinced that there were other "Electric Light and Power" companies in the field. Twenty-three of these "undertakings" infringed their patents and adopted their title—one of them even styling itself "The Electric Light and Power Generating Company," thus displaying a finer appreciation of grammar than of principle. The company has wisely changed its name to "The Maxim-Weston Electric Co."

It well behooves electricians, and all interested in the science to expose the false scientists, men who are rogues first, and electricians afterwards, and it will be wise on the part of the public not to lend too willing an ear to every little device and to every "big" company, that may be brought before them.

J. D.

NEW YORK, July 19, 1882.

SPARKS.

—— A CITY JOURNAL says: It is estimated that upward of 30,000 lives have been destroyed by the explosive products of petroleum.

—— AT ATHENS, Greece, the monuments of the Acropolis were brilliantly lighted up in connection with the meeting of Hellenic physicians recently held in that capital.

—— ON JUNE 8, the first electric tramway in Holland was opened between Zandvoort, a watering place on the Haarlem and Zandvoort line to Kostverloren. The cars and machines have been supplied by Siemens and Halske, of Berlin.

—— AT MEXICO, the House of Representatives of the republic has been lighted up by electricity for some time past. The National Palace, also, which has been hitherto lighted with Argand and paraffin lamps, is to have the electric light applied to it.

—— THE WAR OFFICE, at Madrid, is being lighted with electric lamps and machines furnished by the Sociedad Española de Electricidad, who have purchased the Maxim and Weston light. The city of Irun is about to adopt the electric light for public and private use.

—— THE MUNICIPALITY of Brünn, Austria, have decided to adopt lighting by electricity in the new Urban Theatre, erected in the place of the one destroyed by fire. This new theatre is to be opened in October. At Vienna, also, experiments of electric lighting are about to be made in the palace of the Cisleithan Parliament.

—— WE LEARN that the United States Electric Lighting Co., in consequence of the increased demand for their light, have been recently making extensive purchases of real estate in Newark, N. J., and are now engaged in erecting extensive additions to their factory in that city; their purpose is to concentrate their manufacturing interests there.

—— A CORRESPONDENT from Long Branch, to an evening paper, says: The electric light introduced this year at the West End and Ocean Hotels has excited the envy of the gas company. They have managed to keep the other hotels, as well as many of the cottages, in partial darkness. Ever and anon a street light will flare up spasmodically, but the effect of this sudden and transitory brightness is to correspondingly diminish the light elsewhere.

—— THE PORTRUSH AND BUSHNELS Electric Tramway, near Belfast, the first that has been constructed in the United Kingdom, will be opened in the first week in August. The ceremony will probably be performed by the Lord Lieutenant. The electric railway from Charlottenburg to the Spandauer Berg, near Berlin, is stated to work now with the greatest regularity, and no hitch has occurred there for weeks. On Sundays and holidays only horses are used instead of electricity, because the two electric cars would be insufficient for the requirements of the traffic, and a mixed working of horses and electricity is impracticable.

—— INTERESTING electric lighting experiments have recently taken place in the harbor of Kiel The question of the electric lighting of this most important naval harbor of Fatherland and its surroundings is now being gone into with a will by an Imperial Commission, presided over by Rear Admiral von Wickede. In the two northern forts, Friedrichsort and Falkenstein, and in forts Stosch and Korüggen, at the southern entrance of the harbor, large electric lighting apparatus are put up, which cast such a bright light a league away from the port that no hostile squadron or torpedo boat could by any possibility enter the harbor at night without being perceived.

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—— IN CONSIDERATION of the fact that exhibitions of electricity are to be held this year in Munich and Trieste, it has been decided to postpone the Vienna one until August, September, and December, 1883. This decision has been received with much gratification at Munich, and the *Schwäbische Merkur* states that an additional impetus has been given by the announcement to the preparations for the forthcoming electro-technical exhibition at Munich.

—— A HOME MADE TELEPONE has been devised in New Bedford, which is thus described by the *Mercury:* "Morgan Thomas has recently constructed a telephone, connecting his store on Purchase Street with his residence on Acushnet Avenue, about 1200 feet distant. The telephone is made in accordance with an idea which is original with Mr. Thomas. No battery is used, and the instrument acts on the principle of vibration, but differs from other telephones constructed on this principle, in a diaphragm chamber in which the diaphragm is enclosed. This chamber renders the instrument much more sensitive, and it works more perfectly, from the fact that the wire is not permitted to come in contact with any solid substance, but is suspended on guys of rope. So perfectly does the instrument act, that when a person is talking through the phone in Mr. Thomas's house, the conversation can be heard plainly anywhere in the store. Mr. Thomas has made several of these telephones for friends.

ELECTRICITY IN SURGERY.—*Boericke and Tafel, New York and Philadelphia.*—JOHN BUTLER, M.D.

This book, which may be regarded as a review of the present condition of electro-surgery, is intended as a brief, practical guide for both specialists and general practitioners in the use of the latest improved electro-surgical devices. It is profusely illustrated and appears to be very complete, considering the limits of its aim. It especially dwells upon the estimation of the quantity of current necessary to effect special objects, as, for instance, to coagulate the necessary quantity of blood to cure an aneurism, and on the maintenance of the proper temperature for the electro-cautery in ordinary amputations. It is well worth its cost to any physician.

PATENTS FOR JUNE, 1882.

JUNE 6th.

259,066 Clock, Electric Spring. W. D. Whalen, Howell, Mich.
259,044 Electric Conductor, Underground. G. Richardson, Philadelphia, Pa.
259,045 Electric Conductors, Underground Conduit for. G. Richardson, Philadelphia, Pa.
10,134 Electric Lighting System. W. E. Sawyer, New York, N. Y., and A. Man, (re-issue), Brooklyn, N. Y.
259,077 Electric Machine, Dynamo. C. E. Ball, Philadelphia, Pa.
259,061 Electric Machine, Dynamo. C. J. Van Depoele, Chicago, Ill.
259,186 Electric Push-button. G. C. Maynard, Washington, D. C.
259,130 Electric Wires, Underground Conduit for. C. H. Goebel, Philadelphia, Pa.
259,046 Electrical Conductor, Underground. G. Richardson, Philadelphia, Pa.
259,235 Electrical Fixture. L. Stieringer, New York, N. Y.
258,934 Electrical Signaling Circuit. T. D. Lockwood, Malden, Mass.
258,931 Electrical Switch-Boards, Plug for. H. W. Laland, South Framingham, Mass.
259,086 Fire-alarm Box Apparatus. J. J. Brophy, New York, N. Y.
259,267 Gas-Jets, Electric Device for Turning on, Lighting and Extinguishing. A. L. Bogart, Jamaica, N. Y.
259,271 Insulation, Preparation of Materials for use in Electric. J. A. Fleming. University College, Nottingham, County of Nottingham, Eng.
258,965 Lamp-Bracket, Electric. E. Weston, Newark, N. J.
258,991 Lamp, Electric. C. A. Cheever, New York, N. Y.
259,223 Lamp, Electric. H. B. Sheridan, Cleveland, O.
259,224 Lamp, Electric. H. B. Sheridan, Cleveland, O.
259,062 Lamp, Electric. C. J. Van Depoele, Chicago, Ill.
258,964 Lamp, Electric. E. Weston, Newark, N. J.
259,007 Lamp, Electric-arc. J. H. Guest, Brooklyn, N. Y.
258,976 Lamp, Electric Incandescent. A. Bernstein, New York, N. Y.
258,903 Lamp, Electric Incandescent. M. G. Farmer, Newport, R. I.
259,008 Lamp, Electric Incandescent. J. H. Guest, Brooklyn, N. Y.
259,017 Lamp, Electric Incandescent. E. J. Houston, Philadelphia, Pa.
258,943 Lamp, Incandescent. J. V. Nichols, Brooklyn, N. Y.
258,966 Lamp, Incandescent. E. Weston, Newark, N. J.
258,942 Lamp, Carbon for Incandescent. J. V. Nichols, Brooklyn, N. Y.
258,871 Musical Instruments, Electro-Magnetication for. C. N. Andrews, San Francisco, Cal.
259,226 Telegraph, Automatic. G. Smith, Astoria, N. Y.
259,106 Telegraph, Duplex. B. F. Dillon, Savannah, Ga., and J. W. Brown, Augusta, Ga.
258,957 Telegraph, Duplex. B. Thompson and C. Selden, Toledo, O.
259,057 Telegraphic Receiving Instrument. G. Smith, Astoria, N. Y.
259,225 Telegraphic Receiving Instrument. G. Smith, Astoria, N. Y.
258,891 Telephone. J. W. Clark, Etna, O.
258,989 Telephone Attachment. J. C. Chambers, Cincinnati, O.
258,886 Telephone, Central-office Switch. M. J. Carney, Toledo, O.
258,894 Telephonic Switch Apparatus. H. W. Cozzens, Newport, R. I.
259,115 Toy, Electric. R. N. Dyer and H. W. Seeley, New York, N. Y.
259 054 Flat-iron, Electric. H. W. Seeley, New York, N. Y.

JUNE 13th.

259,367 Candle Holder, Electric. C. A. Cheever, New York, N. Y.
258,614 Electric Circuits, Safety Device for. E. Weston, Newark, N. J.
259,615 Electric Circuits, Safety Device for. E. Weston, Newark, N. J.
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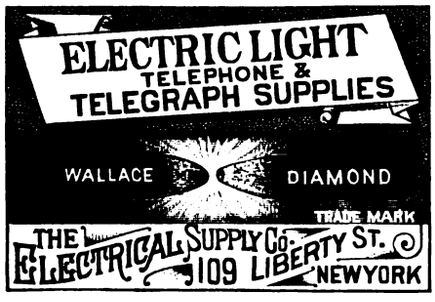

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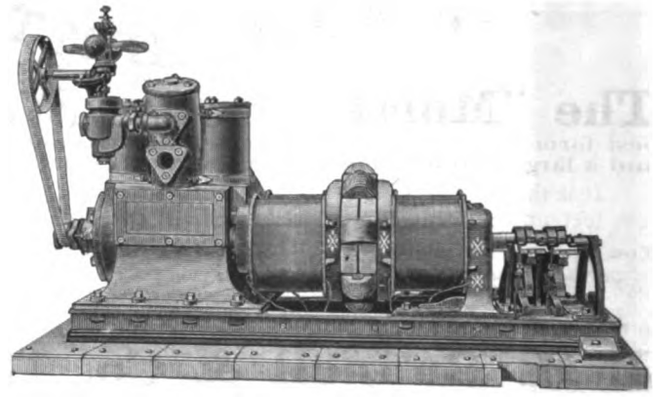

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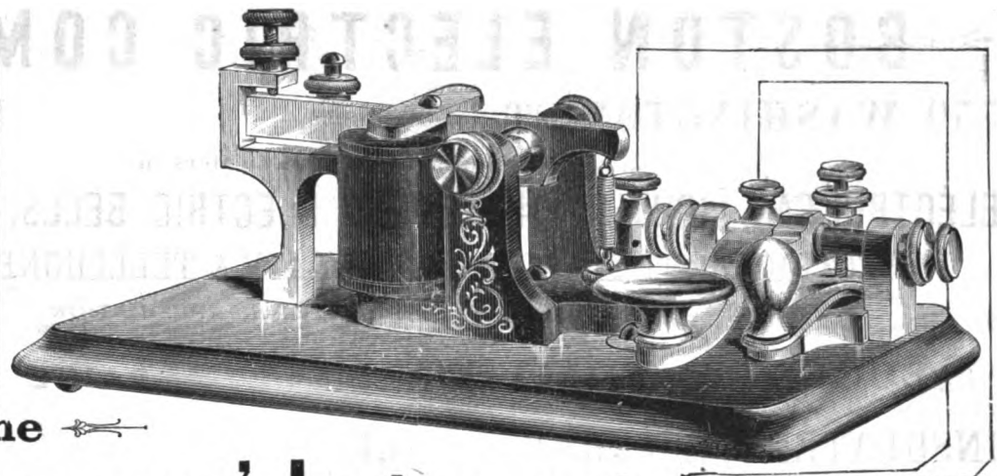

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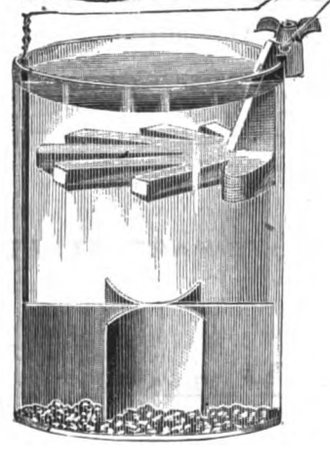

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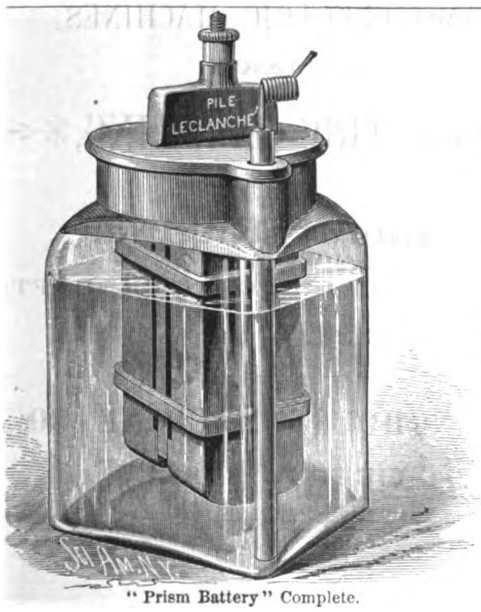

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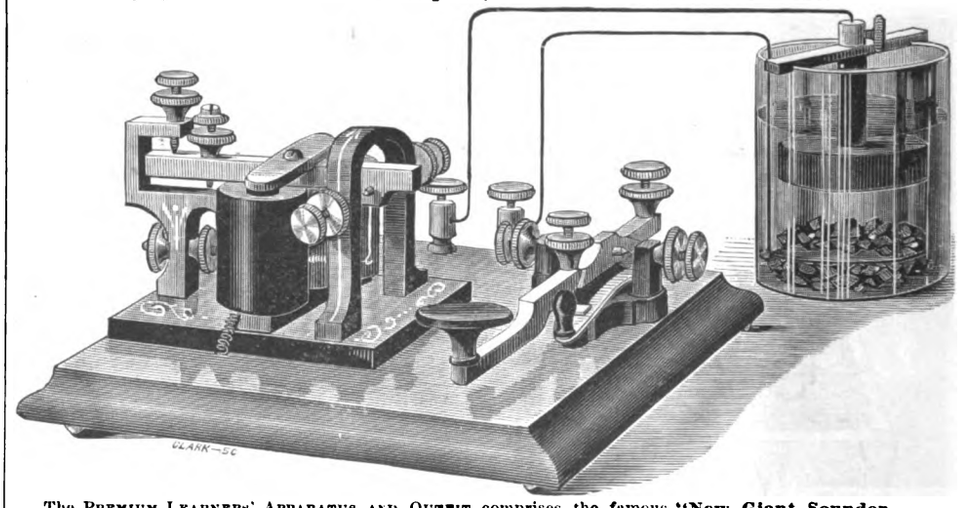

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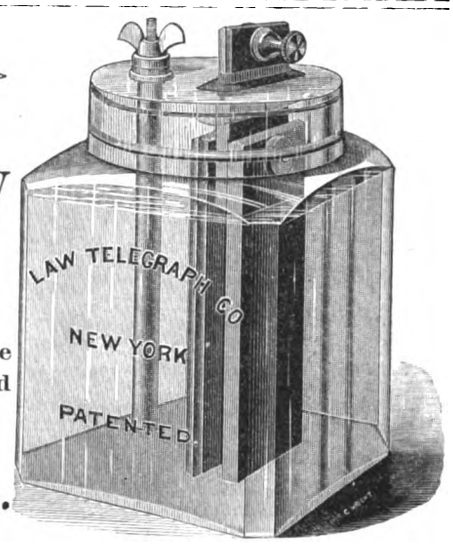

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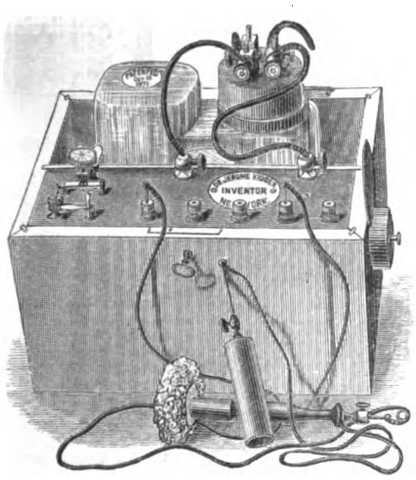

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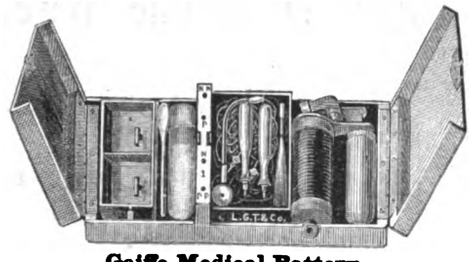

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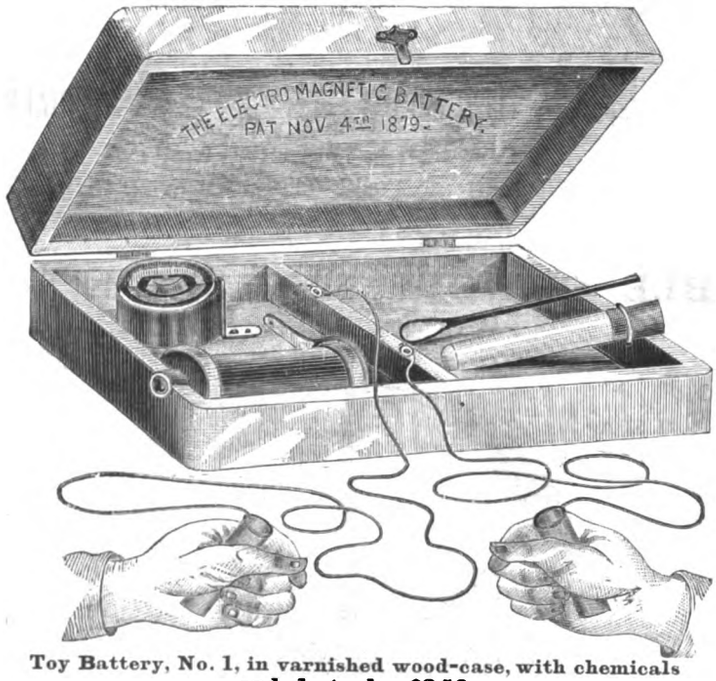

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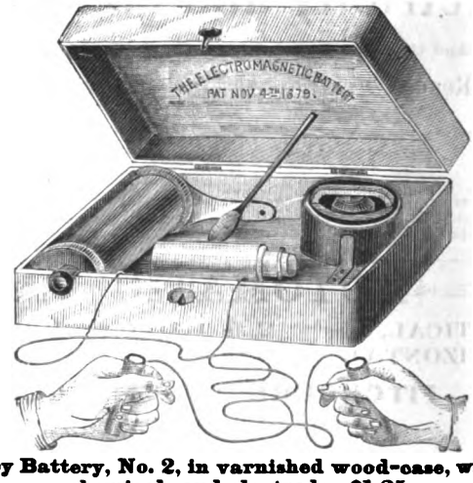

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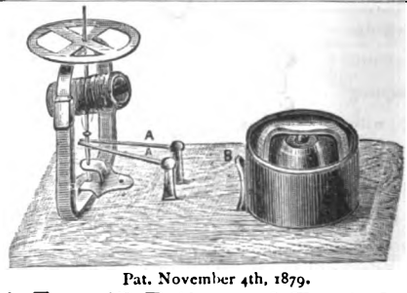

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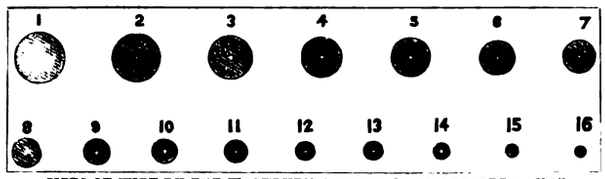

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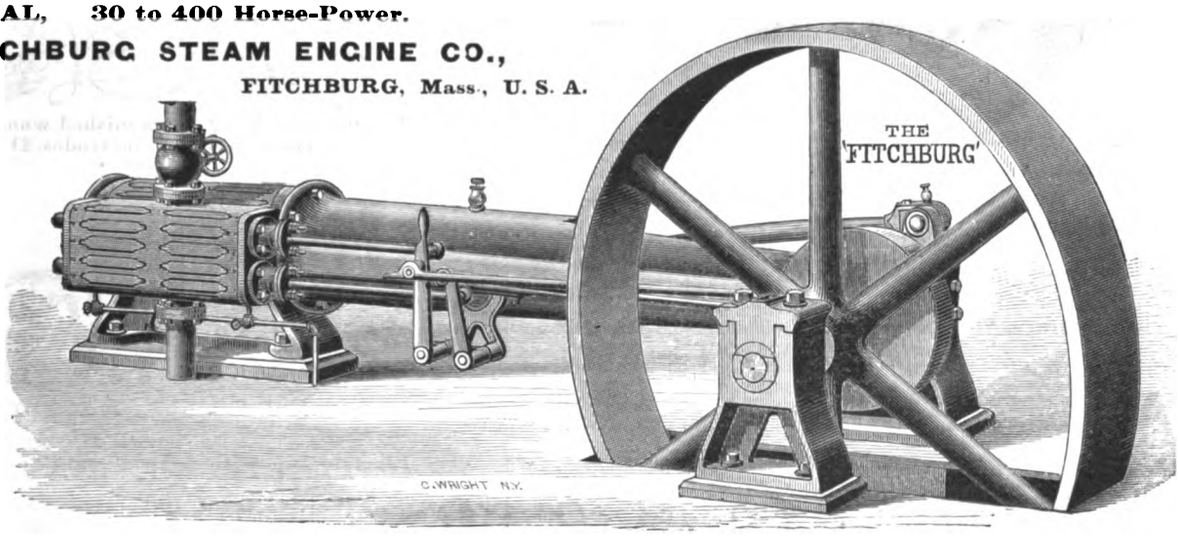

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THE ELECTRICIAN.

Vol. I. No. 11.] NOVEMBER, 1882. [50 Cents a Year. 5 Cents a Copy.

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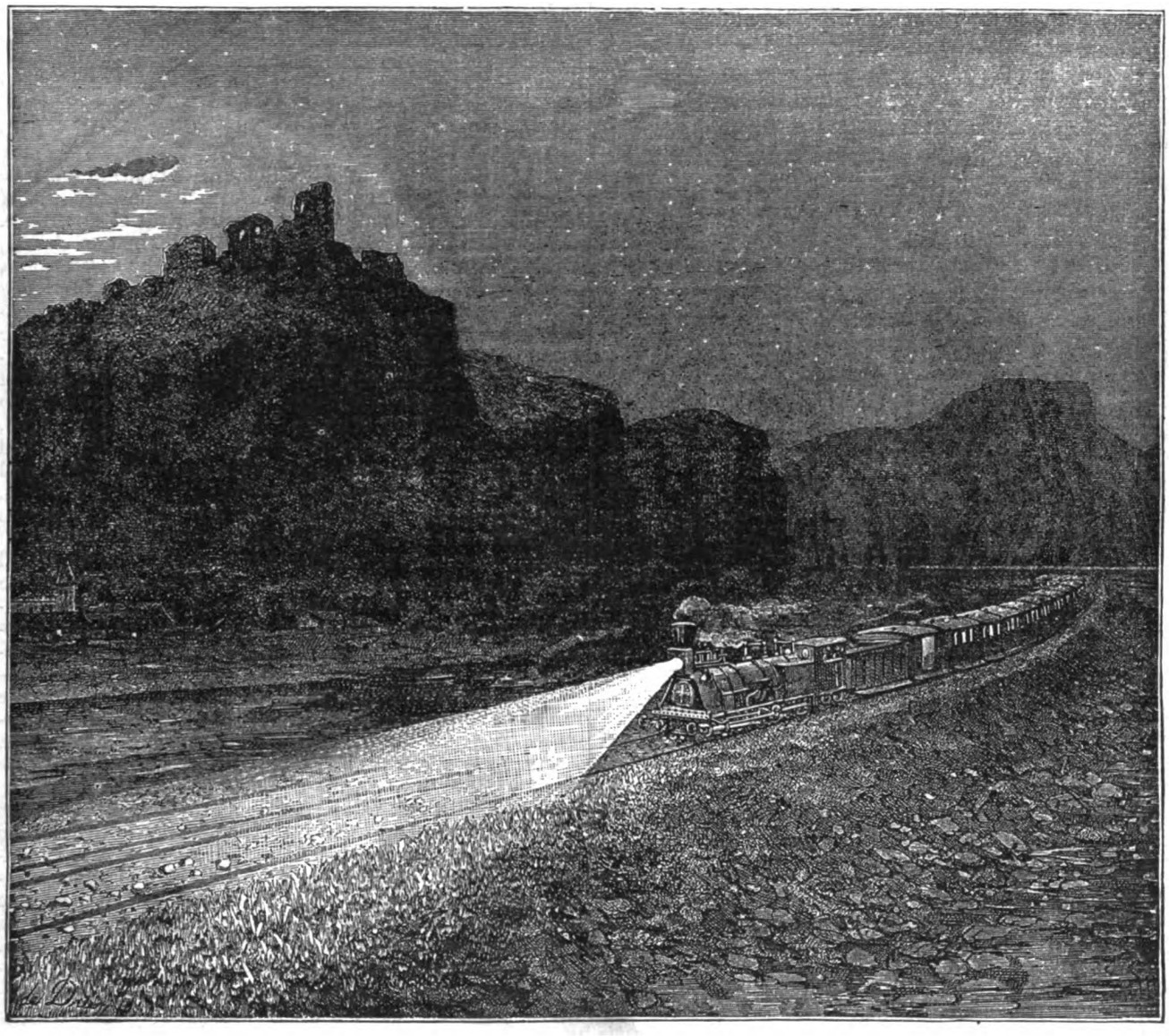
THE ELECTRIC LIGHT APPLIED TO RAILWAYS.

TWO important advances towards greater safety in railroad travel, have been made of recent years, the inauguration of the "block" system, and the application of the electric force, in various forms, and for different purposes. As a means of communication between the guards and passengers, the electric current, has been found extremely useful, but it is as an adjunct to the block system, that it bids fair to insure almost absolute immunity from accidents. The slowness of railroad officials to avail themselves of the immense advantages offered by electricity, seems almost incredible, for its aid is not confined to acting as a swift messenger, but also, as an illuminating agent, rendering the train engineers independent of sunshine, and indifferent to fogs.



RAILROADING WITH ELECTRIC LIGHT.

The application of electricity to continuous air breaks, has been most successful, the arrangement being practically automatic. The various ways in which the force has been utilized for working discs, and giving signals of alarm, etc., would require a chapter to themselves, but the

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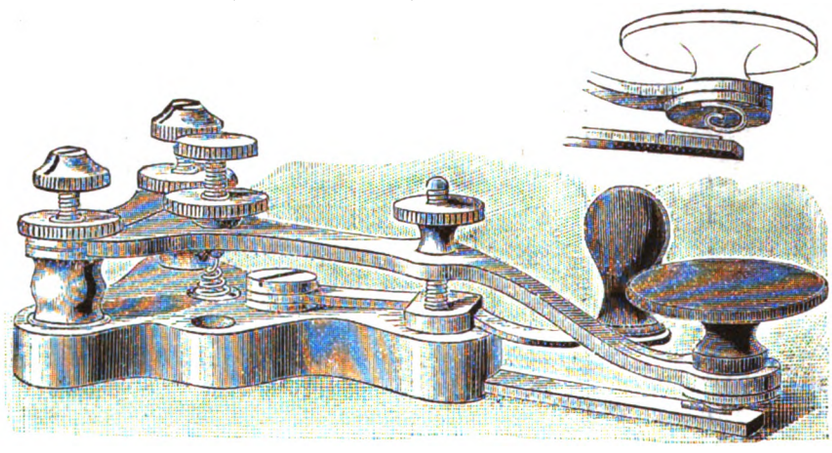
at the extreme back end of the lever, which cannot be dislocated, abolishes trunnions altogether. Steel, instead of platinum, contacts are used, and various devices have been suggested whereby the contact points can be quickly cleaned or renewed. Among these an especially prominent method, is that so widely advertised as the periphery contact, by which, instead of large contact surfaces, the smallest possible points are brought in contact. By means of an auxiliary lever in another key, the break or separation between the contacts is enlarged, without increasing the play. Each of these has been the conspicuous feature of some one key, wherein, as a general thing, all other features have been subordinated to it, and entailed either an imperfect, inconvenient, or expensive method of constructing the key, which has operated against its general introduction.

A patent to Mr. Cyrus Prosch, of the Electrical Supply Co., of this city, for an improved telegraph key, has been recently allowed. Aware of the extraordinary interest that has been awakened among telegraph operators by the remarkably active competition among inventors with reference to this feature of the telegraph service, we hasten to present a full account of it.

In this key, the inventor claims to have combined, in a convenient, cheap, compact, and thoroughly practical manner, as many as ten or more of the old, and some new, distinct and desirable features, as follows:

1.—Top connection.
2.—Small base.
3.—Its lever joint cannot be dislocated.
4.—Light lever.
5.—Contacts at end of lever giving greatest break without auxiliary attachments.
6.—Facility of cleaning contacts.
7.—Smooth wear of contacts.
8.—Large wearing surface of contacts.
9.—Changing both contacts by turning the knob.
10.—All the advantage of periphery contact without its expense.
11.—Novel manner of supporting the lever on the binding posts, whereby expense in construction is saved.
12.—Perfect electrical connection through the lever hinge.



PROSCH TELEGRAPH KEY.

A brief description and reference to the cut, will enable those familiar with telegraph keys to understand its various features. The contacts and their arrangement, shown in the separate view, are most novel. The upper is a piece of platina wire, in the form of a spiral, which turns with the key knob over the lower one, which is a straight piece of wire, secured to a spring arm extending out from the base of the key. It can be seen that when these contacts meet they cross each other, and thus present minute points of contact. If the knob is turned, both surfaces are cleaned, and, at the same time, the points of contact on both are changed, and thus they will wear even and smooth. The large wearing surface is apparent. It will be seen that the contacts being at the end of the key lever, more than double the usual break is had, with a given play to the lever. The spring arm below, provides all needed elasticity to prevent jar.

The joint of the lever is made by the insertion of a thin strip of steel in its end, which is supported on two posts, and secured to them by nuts on top; these supports also constitute binding posts for top connection. There is a connection between the circuit closer lip (which is insulated) and the post, which connects with the lever. The general form and construction ensures beauty, compactness and cheapness, except in the platina, of which there is five to six times more than on other keys.

The inventor assures us that this key has successfully withstood the most severe trials, both on general, commercial and press work, and has proved the easiest working, most rapid, and perfect writing key ever constructed. A feature, resulting from its great break between contacts, is, that even in constant use, it cannot stick, and, for the same reason, its adjustments seldom need alteration.

Mr. Geo. W. Prosch, the father of the inventor of this key, made the original telegraph instruments of Prof. Morse, and their success was probably due, in part at least, to his well attested mechanical skill. In the expectation that no defect in it will be revealed, we trust Mr. Prosch's key to the final test of extended practical use.

THE ELECTRIC MOTOR OF MR. W. W. GRISCOM.

IN mentioning the recent electrical inventions on exhibit at the American Institute Fair, in our November number, we referred to a small dynamo machine exhibited by the Electro-Dynamic Company, of Philadelphia, and the invention of Mr. W. W. Griscom, of that city. A more extended description, from *L'Electricien*, of this ingenious application of electricity to domestic uses, is deserved, and will doubtless prove interesting.

It has been especially the purpose of Mr. Griscom to contrive a light, compact, simple and yet strong motor for application to sewing machines, lathes, ventilation, etc.

The subjoined cut represents the little motor of Mr. Griscom applied to a sewing machine. It is only ten centimetres (about 4 inches) long, and its weight does not exceed 1140 grammes (about 3¾ ounces). Small as are these dimensions, it can produce, with an appropriate current of electricity, from 3 to 4 kilogrammetres of power, and it attains a velocity of nearly 5,000 revolutions per minute. It consists of a Siemen's bobbin revolving between the two poles of a consequent point electro-magnet, and the bobbin is, therefore, wholly enclosed by the inductor. We shall see directly the electric effect resulting from this peculiar disposition. The current is carried to the bobbin by little rollers running on the commutator.

The bobbin and the annular electro are of malleable cast iron, the attractive power of which is almost as small as that of cast iron. This renders its manufacture very economical. The action is most simple, and identical in principle with all Siemen's bobbin motors. There is, however, in the Griscom motor a special phenomenon that is found in no other, and of which we must say a few words.

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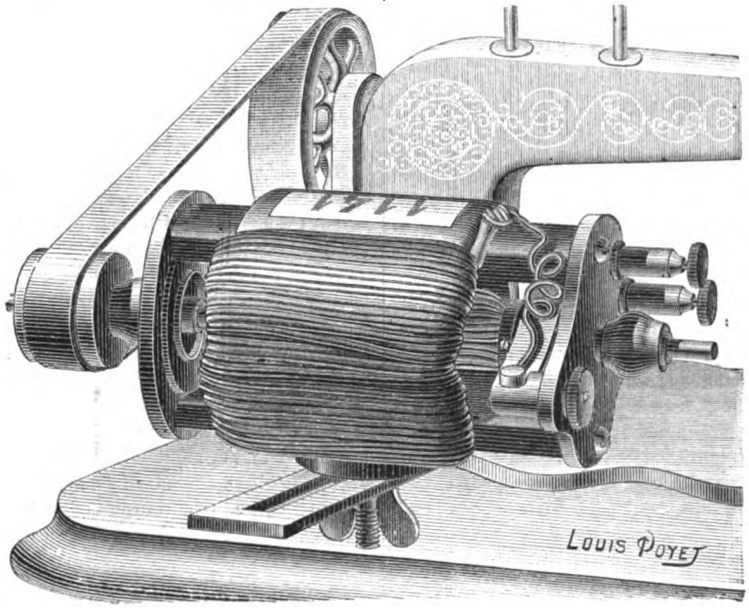
By reason of the annular form of the fixed armature, the mobile armature passes very close to the wires which surround it, and as the mobile armature is an electro-magnet, induction currents are developed in it. Closely studying the direction and the nature of these induction currents, it will be observed that they are produced upon each half by a pole, always of the same name, because the commutator passes before the helix *S* always in the same direction, because of the continuous rotation of the bobbin. These currents are, therefore, in the same direction as those which magnetize the fixed armature; they tend therefore to augment the power of this armature, and the inductive action arrives at its maximum, at the moment when the axis of the bobbin makes a right angle with the line which joins the two poles of the fixed armature. The interest of this disposition is, that a powerful magnetic field is determined with a relatively small quantity of wire upon the fixed armature, because the intervals during which the axis of the Siemen's bobbin is at the greatest distance from the poles, which are to attract it, are utilized to produce the reinforcement of this magnetic field.

Mr. Griscom shows this reinforcement by the aid of a special motor, in which the extremities of the wire of the fixed armature are free, and the current from the battery then passes through the bobbin only. If under these conditions the circuit of the fixed armature be open, the motor moves very slowly and even stops occasionally. If the circuit of the fixed armature be closed within itself, the rapidity of the motor is enormously increased, the induction currents developed in the wire, which forms the closed circuit, then continually polarize the stationary armature, and maintain its magnetism with the polarities adapted to the direction of the rotation.



GRISCOM'S MOTOR.

In consequence of its presenting this very interesting phenomena, to which we particularly called the attention of our readers, Mr. Griscom calls his apparatus a "*double induction motor.*"

This motor may be easily applied to any sewing machine, already in use, a little straight support, and a nut or thumb-screw under the motor, being sufficient to fix it in place.

The entire battery is contained in a box which serves for a seat for the operator, and by means of a foot pedal, conveniently placed, the battery plates may be depressed into the liquid in the cells or raised out of it, and the speed of the motor thereby nicely regulated, for its rapidity obviously depends on the intensity of the current by which it is driven.

This is one of those rare cases, where the regulator of the current acts upon the interior resistance of the battery.

The battery contains a quantity of liquid large enough to last a long time without renewal. The duration evidently depends on the amount of work done with the motor. Mr. Griscom states, that one charge of the battery will sew 500 to 1,000 metres (from 540 to 1,083 yards) of seams, let it be all at once, in fifteen days, or slowly in six months, or at irregular intervals.

This motor seems particularly interesting by reason of the induction phenomena we have alluded to, and especially because it is so nicely adapted for domestic purposes.

ON THE FUTURE OF ELECTRIC LIGHTING.

WE take from a recent *Journal of the Royal United Service Institution*, a portion of a paper read before that Society, by Mr. St. George Lane Fox, on the above subject, and regret that our limited space prevents our publishing it in full. In introducing Mr. Fox to the meeting, the President of the Royal Society, observed that Mr. Fox "was not only an inventor, but one who has carried his own invention to perfection."

During the last few years, and more especially during the last few months, electric lighting has made very great and remarkable progress. But great and remarkable as this progress has been, I do not think that it is to be compared to the advance that is likely to be made in the immediate future, I shall not, however, in the few remarks I have to make, pretend to withdraw the veil entirely from that future, The subject is too vast and too complicated for me; much of it must be left to the imagination of my audience. I shall content myself with indicating the mode in which I think light will come to be produced by electricity, and I shall begin by replying to one or two pertinent questions which the public are ever asking with respect to it.

They say, first of all, "Shall we ever have the light in our houses?" Next they say, "Shall we have to produce the electric current ourselves?" And thirdly, they ask, "Will it be cheaper, or even as cheap, as gas?"

I shall endeavor to answer those three questions. I think I may say at once that we are now in a position, from our knowledge and our experience, to answer them all in favor of electricity. There is not the slightest doubt in my mind that we shall have the light in our houses; and on the other hand it will not be necessary that the consumer should supply himself with the electric current any more than, at the present time, he is obliged to supply himself with gas. It would, however, be just as possible for him to do so. The third question is one which involves a great many considerations, but I think I can answer it also affirmatively, indeed I have no doubt that electric lighting will be cheaper than gas. I will now, if you will allow me, give as nearly as possible the reasons which have brought me to those conclusions.

And first, as to the light and the devices made use of for its production. The light itself, by an improvement in the mode of its production, has lately undergone an important change for the better. People speaking of it hitherto have usually supposed it to have certain inalienable qualities, and some of them very bad ones. They have supposed it to be brilliant, dazzling, flickering, changeful of hue and intensity, unbecoming to the complexion, and so on; in fact, to have many qualities making it unsuitable, if not for signaling or wide open spaces, yet for domestic use, But in so describing the light they have, I think, had in their minds the so-called "arc" light only. Now the arc light has done very much for the progress of electric lighting, and what I am

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about to say may seem strange and ungracious, but it is, I believe, nevertheless true, that in a short time the arc light will be altogether superseded by the more modern and much more convenient "incandescent" light. I may pause here to point out the impropriety of those names. In all cases light, when produced by electrical energy, is due to incandescence. However, the names have now got a current and popular meaning attached to them, so I will not attempt to further meddle with them here. To proceed, the so-called "incandescent" light has none of the disagreeable characteristics of the "arc" light. It is not too brilliant nor too dazzling; it requires no shade to temper its use; it is neither flickering nor changeful of hue or of intensity, and it is not unbecoming to the complexion. In the "arc" light, the light is produced in the open air by an intensely heated and variable gaseous conductor, composed in part of the common air and in part of vapor of carbon, playing upon and between the points of two carbon pencils, the points of the pencils being, by the action upon them of the gas, raised to a very high degree of incandescence. The gaseous conductor is heated by the electric current passing through it from one carbon pencil to the other. In the "incandescent" light so called, the light is produced in vacuo by the action upon an invariable solid conductor, generally a filament of carbon, of an electric current kept at a constant pressure. It will be seen that the conditions of the two lights are entirely different, and that in the case of the "arc" light the conditions are such as to make variations in the quality of the light produced almost inevitable whilst in the case of the "incandescent" light the conditions are such as almost to guarantee a light perfectly steady and uniform in its character.

With respect to the device by which the "incandescent" light is produced, most of you are now, no doubt, familiar with at least the outward appearance of the incandescent lamp. It consists chiefly of a glass globe, from which the air has been as completely as possible exhausted, and in which there is a carbon filament mounted on two conducting terminals. Now this sounds very simple indeed, but there are a great many points to be attended to on the part of the manufacturer of the lamp. It is not difficult, and it has not been for several years, to make a good incandescent lamp; but to make a large number of them, so that they are all good and all alike, is quite a different matter. I do not say it is now difficult, because the difficulties are gradually disappearing, but it required a great deal of work, thought, and study in former times. It introduced altogether new subjects. We have to deal with people other than those engaged in scientific pursuits, and to train them up so as to make them do their work properly. For that purpose we have had to devise a great many means of saving labor, and making it unnecessary that they should think at every stage. I may tell you briefly what the chief points are in the construction of an efficient and durable electric lamp. First, the material solid conductor or carbon filament should be sufficiently strong. Various carbonized substances can be used for the purpose When I began experiments I used every conceivable material —orange peel, pieces of wood and paper, and vulcanized fibre, and all manner of things. I finally thought it was scarcely possible to get the right material. But by degrees I found that there were other difficulties in the way besides getting the right material. We found we were not getting so good a vacuum as we supposed we were. We thought, when using a Sprengel pump, that if the mercury made a clicking sound in the tube, the vacuum was complete. This was, however, no real criterion. The only way in which we can exhaust a globe or glass vessel is by taking the pressure away from the outside, so that the gas, by its natural expansive power, can force itself out. Now, if in the exhausting apparatus we use there is any opposing pressure, due to the presence of moisture, the residual gas, after a certain degree of exhaustion has been attained, has not sufficient expansive power to overcome it, and ultimately an exact balance between the two is arrived at. The highest degree of exhaustion is thus measured by the actual pressure or tension of any moisture which may have found its way into the apparatus. To shut this moisture out of the pump, and hermetically to seal the junctions of the mercury with the glass and sides of the apparatus, I used sulphuric acid, an acid in the form of a liquid which gives off no vapor in a vacuum. This was the first and most important advance I made towards the completion of the lamp. I was obliged, however, finally, to abandon the use of the Sprengel pump and to invent another more adapted for the purpose. My own, I think, is at once more rapid and more effective.

The next point is the necessity of keeping the electric connections between the inside and outside of the globe perfectly hermetically sealed. The only material we can use, so as to make a close joint, is platinum. There are others that can be used, but not so practical. The difficulty, however, remains that there is still a slight difference between the expansion of glass and that of platinum, the result is that a slight annular space is left between the glass itself and the platinum wire which leads the current into the inside of the globe. I have tried to overcome that difficulty by putting little globules of mercury round the outside of the platinum wire. It gave rise to difficulties at first; but now I think that is very effective in preventing the air passing in between the platinum wire and the glass.

I will not trouble you with any more details of manufacture; but I will call attention to the material out of which the carbon fibre is made. It is the root of a grass known as French whisk. This material is prepared by boiling it in caustic soda, so as to remove the traces of silica which are to be found on the surface. It is then thoroughly washed, and while still damp, wound tightly round and tied upon small blocks of graphite. These blocks are buried in plumbago and intensely heated. By this means a very strong and durable carbon filament is obtained.

The lamp as a whole is exceedingly portable and convenient, and is always quite ready for use. It requires no trimming or adjustment when once mounted in an electric circuit, and it is suitable for use in houses, places of business, &c., as well as in the streets and public places

We now come to the distribution of electricity, upon which hangs the answer to the householder's question, "Shall I have to produce the electric current for myself?" I hope to be able to show that he will not, and that he will have to think no more about this source of his supply than he has at present to think about that of gas.

A few years ago it was generally believed to be altogether impossible to distribute electricity or the electric current as gas is distributed. A Select Committee of the House of Commons apparently came to that conclusion, in 1878; and it is true that at that time nothing had been done to demonstrate the contrary, or to show that distribution on a large scale, or a scale similar in every way to the scale on which gas is distributed in the metropolis, was so much as practically conceivable. Now things have altered very much, and there is no longer any doubt that electricity can be transmitted and distributed for every purpose, and in every way as easily, if not more easily, safely, and economically than gas.

Mr. Fox then described, in a very concise and interesting way, the difference between electricity and the electric current; the system of distribution so far as relates to the central station; the secondary batteries, the construction of the arc and incandescent lamps; the return portions of the circuit; the means for keeping the electro-motive force of the electric conducting mains constant; and the means for measuring the quantity of the electricity used. In referring to the manner by which electricity may be introduced into houses, and its economy as compared with gas, he said: I have now described, how I conceive the electric current may, in any district, be distributed and be brought to the houses of the consumers without any other trouble in kind, and with much less, I think, in degree, than is incident to the consumption by them of gas. The householder will have the current laid on to his house at a known and constant pressure day and night. He will be able to determine for himself to what extent, in what rooms, and in what modes, and to what purpose he will apply it. And he will be able to choose for himself the particular lamps, whether Edison's, Maxim's, Swan's, or my own, which he may deem most suitable for his purpose. He will be left at perfect liberty. The only demand upon him will be a demand from the central station for the price of the quantity of electricity which the meter in his house may record against him. And I may leave this part of my subject with the expression of my hope and belief that that quantity will, ere very long, be found to be, in every case, very large indeed!

Now, I should like, if you will allow me, to go into the third question, the question, viz., of the economy of electricity as compared with gas. I may

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first say that my reason for believing that the incandescent lamp will ultimately supersede the arc, depends not only on its great superiority in point of convenience and easy management and steadiness, and the fact that its light has no color; but I believe that in time it will actually prove to be more economical. In the arc light it is necessary to remove the carbon pencils from time to time as they burn away. This removal is expensive, requiring, as it does, skilled labor for the purpose. An incandescent lamp once mounted requires no attention, and if properly made will last so long good that its cost may be thrown out of account in any estimate that may be made of the comparative economy of electricity and gas when that lamp is used. This gives a great advantage to the incandescent over the arc lamp. In the estimate I am about to make, I shall assume that the former lamp is used, and I shall not take its cost into the account. I must premise that of course we have not got actual results to go by on a scale anything comparable to gasworks, so that we cannot give figures of what has been done. Still I think our knowledge of the subject justifies me in drawing some conclusions. We know that by the expenditure of a certain amount of fuel we can produce a certain amount of power. We know that on a large scale, and with good machinery, a combustion of 1¾ lbs. of coal will yield one horse-power for an hour, and we know what one horse power will do in producing light by incandescence; we know that that amount of energy expended in raising a certain extent of surface, whether continuous or broken up into several lamps, to a certain temperature, will produce a total light equal to 150 candles. Knowing then that an expenditure of one horse-power is about equal to an expenditure of 1¾ lbs. of coal per hour, and that by the expenditure of one horse-power we can get a total light of 150 candles, we can calculate on that as a basis. Supposing that we took the cost of fuel to be about one-third of the total cost or expenditure for the production of energy—I think we may fairly assume that, if we take the case of very large works, works on a really large scale—we could then retail energy at one farthing an hour per horse-power, that is to say, we could actually produce the power, and sell it at a profit at that price. It seems a low figure, but if we remember we are to have works for the sole purpose of developing energy, the cost will surely be very much lower than where the actual production of power is quite a subsidiary matter, as it is in ordinary factories. I say that a farthing is a very fair estimate of the cost of horse-power per hour. I wish to press that matter very strongly, because the result I am going to arrive at is very astonishing. An ordinary gas jet, burning five cubic feet per hour, taking an average price, costs one farthing per hour. Now I have shown that energy can be produced at the rate of one farthing per hour per horse-power, and that will produce light equal to 150 candles. An ordinary gas jet is equal to twelve candles only, so that for the same price twelve times as much light can be produced by electricity as by gas. Probably that seems an extraordinary result, but it is within the region of probability.

I should like before concluding to show how electricity can be used for other purposes besides lighting. We have already seen that one horse-power per hour can be produced at a certain price—one farthing—and this represents a certain amount of heating energy, which can be utilized in any way you please. It may be used to raise a lower temperature to a higher in the case of water, coffee, chocolate, and so forth. Here is a cylindrical cup or apparatus (describing), consisting of one cylinder enclosed in another, intended for that purpose. There are two terminals, one to be connected with the main, the other with a return conductor. On making connection with the main, the current would pass through a length of wire coiled round the outside of the inner cylinder, and between it and the outer cylinder, the two cylinders together forming the sides of the vessel. The larger portion of the heat energy would be absorbed by the inner cylinder, and the inner surface of the vessel would become hot. If there is a liquid inside the vessel that liquid would take up the heat. The wire is surrounded on the outside by flannel or felt, so that the heat may not be lost by radiation to the outer cylinder, which, again, protects the flannel or felt, and keeps it from wearing away.

This particular apparatus holds, I think, about a quart, and the energy which would have to be expended upon four of these incandescent lamps would be sufficient to make it boil in about five or six minutes. Now if we imagine for an instant what that really means we can see that the cost will be very small indeed. The energy requisite for the incandescence of four lamps for a few minutes would be much cheaper than gas, would be indeed next to nothing. I believe, in the not distant future, we shall have an apparatus, similar to this in construction, in all our kitchens for boiling, stewing, or roasting, or any other kitchen purpose.

I should also like, had I time, to refer to the application of electricity to motion, but I do not think that I can venture to go into that now. We know, however, that there are certain useful forms which electricity can take, such as light, heat, and development of motive power; and when once we have got electricity laid on to our houses we shall find these, and perhaps a great many more uses for it. We can hardly imagine the changes it will introduce into our daily life; one thing is that it will save us all a great deal of time. We shall have no trouble in the lighting by electricity as we have with gas; we shall have always only to turn a cock to have it on or off; it will be always ready at any moment if we have a proper system of distribution and storage, and so I can imagine that when once it is in the hands of the public they will make good use of it, and find many other applications for it which have not yet been found. It is really only a matter of time, how long or how soon, this extraordinary change will come about.

In reply to a question at the conclusion of this address, as to the dangers of electric lighting, Mr. Fox said: In answer to the question as to the danger of electric lighting, I may say that I have heard a great deal about it; but I do not think that there is anything in it. The danger takes two forms; first of all, the danger of shock, and the physiological effect it will produce; and secondly, the danger as to fires. As I have already pointed out, the tension in the method of distribution I propose will be comparatively very low, and it is only when the electricity is pressed or raised to a very great degree of strain that it is able to overcome the resistance of the body to such an extent as to produce any serious result; and I do not think that in any practicable scheme, such as will be adopted in the future, such a high degree of strain will ever be required. The difference between high and low tension is simply this. In the first case, we use a small quantity of electricity, driving it away and making it do a great deal of work; in the second case, we use a larger quantity of electricity and do not drive it to such an extent. The cases are similar in their results with regard to work; but they vary in their means, much as a high-pressure steam engine differs from a low pressure engine. In regard to the danger from fire, I think I may answer that, altogether in the negative. If proper people take the thing in hand and proper precautions are taken, I do not think there will be any danger at all.

—— *Nature* says: The International Electrical Conference, which has been sitting in Paris for the last fortnight, has, after passing several resolutions, adjourned to the first Monday of October, 1883. In regard to electrical units it was resolved, that at present there is not a sufficient concord of view to enable the numerical value of the "ohm" in the mercurial column to be definitely fixed, and that all governments be appealed to by France to encourage further research on the subject. The section for "Earth Currents and Lightning Conductors" resolved, that Government should be requested to favor regular and systematic observations of atmospheric electricity upon their telegraphic systems; that it is important for the study of storms to be extended to every country; that wires, independent of the telegraphic system, should be provided for the special study of earth currents; and that, so far as possible, the great subterranean telegraphic lines, particularly those running north and west, should be utilized for the same purpose; observations being instituted on the same day in the various countries. The section for fixing a standard of light, expressed the opinion that the light emitted by a square centimetre of melting platinum would furnish an absolute standard. In closing the conference, M. Cochery, the Postal Minister, assured the members that the French Government would endeavor to give effect to their resolutions by representations to the various governments concerned. It is hoped that the twelve months, for which the conference is adjourned, will be sufficient for the searches in the various departments in question to be completed. England is indebted, solely, to the private enterprise and spirit of Sir William Thomson for being represented at all. Between the French Government, the Foreign Office, and the Science and Art Department a sad mess has been made. The Post-Office Telegraph Department was never asked to send a representative, nor have any of those who took such an active part in the conference last year been asked to take any part in this. A more disgraceful muddle has never previously distinguished our "how not to do it" system.

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THE ELECTRICIAN.

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TO OUR PATRONS.

THE present number concludes the first year and first volume of THE ELECTRICIAN. How far we have succeeded in keeping pace with the "sounding fury" of our "manifesto," in the initial number, is best indicated by the kind, cordial and increasing support that has been given us with every successive issue. It has been our aim to make THE ELECTRICIAN the special organ of the scientific and industrial interests of Electricity, recording and illustrating inventive activity both here and abroad, and inviting discussions and contributions upon every branch of the subject —rigidly excluding extraneous matter. To what extent we have succeeded, we of course leave others to judge.

With the growth of the electric industry, the demands upon our columns have been, from time to time, increased; starting with sixteen pages in our first number, we were compelled to make our second twenty, our fourth twenty-four, and our last (a double number) forty, never permitting our advertisements to encroach upon our reading matter, but on the contrary, constantly increasing the volume of the latter. All this has involved great additional expense, and naturally necessitates our raising the subscription price to *one dollar a year, and ten cents* for a single copy, which we do not doubt will be cheerfully met by our many readers, for, at this advanced rate, we believe that the paper will be found to be the lowest priced scientific publication in this country. In placing the price of the first volume at fifty cents per annum (insufficient to cover cost of paper and printing), our aim was to give the public a good opportunity of judging its merits. It would have been easy to have lessened its expenses in many ways, but our belief is, that a serial like THE ELECTRICIAN should be to a great extent "a thing of beauty" which, although it may not be "a joy forever," will yet be worth preserving in a bound form. In returning our grateful acknowledgements for the kind encouragement we have received, and which will prove a strong incentive to renewed exertion, we take pleasure in stating that we have made arrangements for the future, that we are confident will be acceptable to our patrons.

The progress of electrical science will doubtless soon cause greater demand on our resources; we trust we shall be able to satisfy them, and will honestly strive to promote the interests of our readers.

THE ELECTRIC LIGHTING SYSTEM OF THE FULLER ELECTRICAL CO.

IN our two previous numbers we gave some account of the business and progress of two large corporations, engaged in the business of supplying electric lighting apparatus to the public, which is rapidly becoming educated to the fact, that this new method of illumination is not only a practical success, but as its numerous and very important advantages come to be better understood, it is already recognized as a necessity; and the manufacture of apparatus for the purpose of supplying it, has taken its place among the great industries that contribute to the welfare and happiness of mankind.

We now place before our readers, based upon information derived from the company, a brief account of another of the few companies who have produced a satisfactory electric light, and whose success in its introduction they claim, has probably been as great, proportionately, during the past twelve months, than that of any other company. We refer to The Fuller Electrical Company, whose principal office and laboratory are in New York City, in the large and handsome building of the Wheeler & Wilson Sewing Machine Company, No. 44 East 14th Street, and No. 45 East 13th Street, and whose manufactory is at 257 and 259 Water Street, Brooklyn. This company takes its name from Mr. J. B. Fuller, who was one of the first to undertake the manufacture of dynamo-electric machines, for the purpose of electro-plating, and the operation of telegraphic circuits, and to prove that electric lighting, which, in theory, had long been known to be possible, could be developed into a thing of general practical utility, and made a commercial success.

The dynamo-electric machine adopted by this company, after a long series of experiments with various forms and theories, is essentially of the type known as the Gramme, this company being the original proprietors, in the United States, of the Gramme patent, which it has transferred to the Gramme Electrical Company, a combination of several principal electric lighting companies actually engaged in the business of manufacturing apparatus, and designed to afford mutual protection to the companies comprising its membership. The conditions of this transfer are peculiarly favorable to The Fuller Company, affording it increasing advantages as the strength and influence of the Gramme organization are extended. The dynamo machines of The Fuller Company, however, possess several advantages over the original Gramme machine, adding to its mechanical strength and durability, without detracting in any degree, from its electrical superiority, which is almost universally recognized

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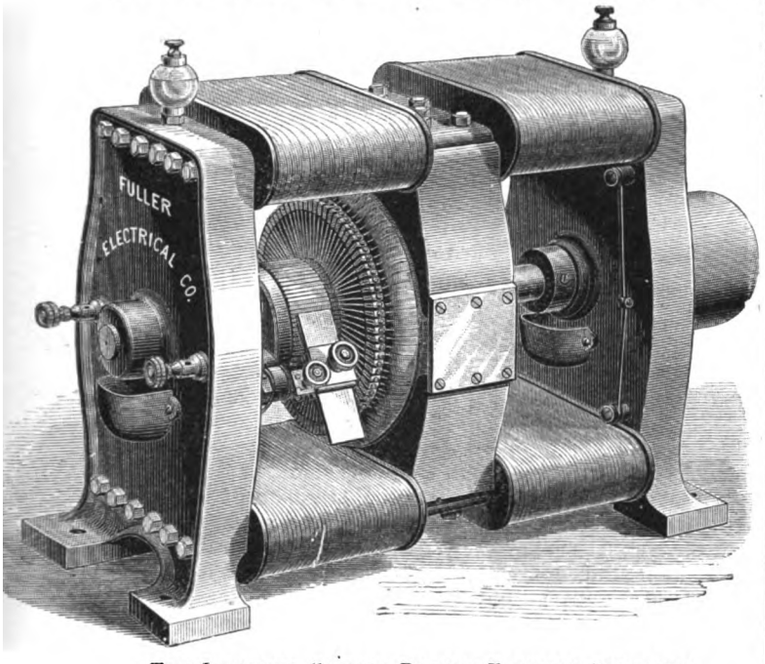
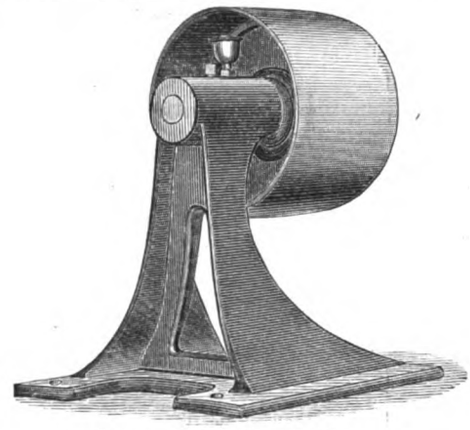
among electricians. The following cut is a fair representation of this machine; this form being uniformly adopted for the different sizes of complete apparatus manufactured by the company. Its great simplicity, strength, and dura-



THE IMPROVED GRAMME DYNAMO-ELECTRIC GENERATOR.
(Wood's Patent.)

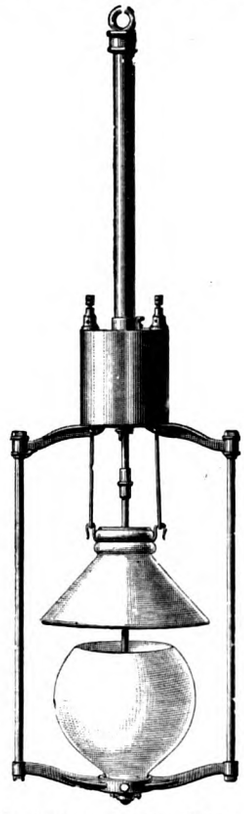
bility are apparent from its appearance. Its frame is made of cast iron side plates, which are connected by the field of force magnets. The poles, which almost entirely enclose the armature, are bolted to these magnets, and are firmly connected with each other by composition plates of non-magnetic material, thus preventing vibration or change of position of the poles. This construction of the frame gives great strength to the machine, and at the same time affords the greatest possible amount of magnetic force. The armature, in which the electric current is generated, is a ring of soft iron wire. This ring is tightly fastened to its hub by a series of keys, and is closely covered with coils of insulated copper wire. The commutator is composed of s many narrow sections of copper as there are separate sections in the armature. These sections are insulated from each other, and their mechanical construction is such, that any section can be readily removed without changing any other part of the machine. The brushes are thin and narrow strips of copper, held firmly in position by a brush-holder, preventing vibration, and retaining them in contact with the commutator by a thumb-screw attachment. The company manufacture these machines of various sizes, from one adapted for operating a single light, weighing 250 pounds, and occupying a floor space of 10x24 inches, to one capable of producing 30 lights, occupying a floor space of 24x48 inches, and weighing a little more than 3,000 pounds. All the parts of each size of machine are uniformly constructed so as to be interchangeable, and the several features peculiar to them, and the combination of their several parts, are secured to The Fuller Company by numerous letters patent of the United States, Great Britain, Germany, France and the Dominion of Canada; and the claim made by the company, which seems to be abundantly borne out by the statements of the large number of users of this apparatus throughout the country, is, that it produces the maximum of light by the minimum of power, and requires less constant attention in its operation than any other successful machine.

The company manufacture for use in connection with these machines, a standard, and loose pulley, (as indicated in the accompying cut,) affording a means of stopping the machine, by shifting the belt, without stopping the power. Its use is not required in all cases but when needed—and it is sometimes important—it is bolted back of the machine, and holds the loose pulley concentric with the driving pulley of the machine. It is fitted with a stationary oil cup, so arranged as to allow the bearing of the loose pulley to be oiled while in motion.

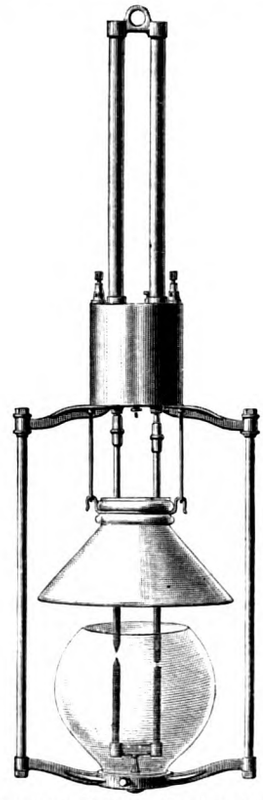


STANDARD AND LOOSE PULLEY.

The following cuts represent the several forms of lamps, single, duplex, ornamental, focusing, and street, manufactured by this company. We are not able, at this time, to furnish such representations of their interior construction



SINGLE OR SERIAL LAMP.



SINGLE OR SERIAL DUPLEX LAMP.

as we have done in the case of the standard lamps of other companies, and as we hope to do in the case of The Fuller Company's lamps in another number. The following gen-

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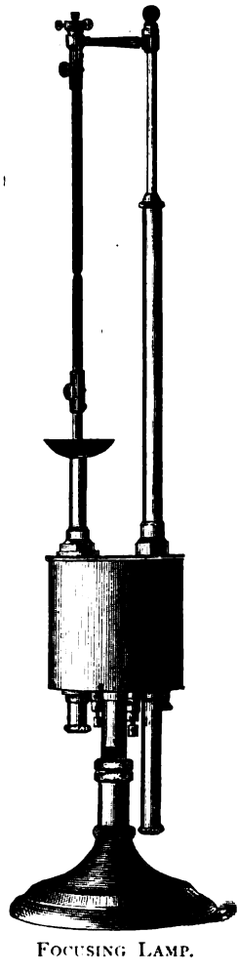
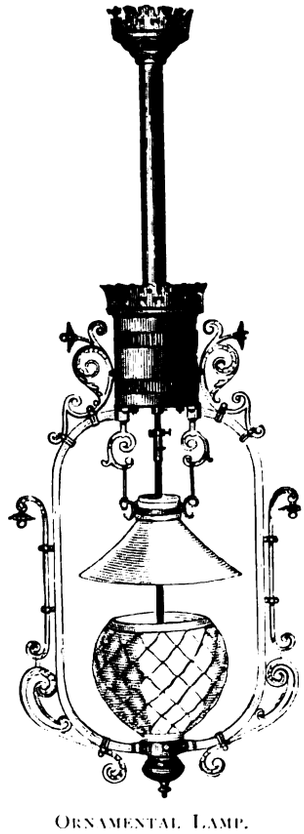
eral description, however, will perhaps give as clear an idea of their peculiarities as any one, other than a scientific reader, will be interested to obtain:

The Single Lamp consists of a hollow suspending tube —of a cylinder, containing the mechanism for regulating the movement of the positive carbon pencils—and the frame in which the carbon points are held, as also the globe and shade, when they are used. This lamp is designed to be used either singly, or as one of a series, and it may be operated in connection with either the duplex or focusing lamps, or both, whenever desired. The carbons chiefly used are $\frac{7}{16}$ inches in diameter, and burn an average of eight hours.

The Automatic Duplex Lamp is of similar construction, except that it has two suspending tubes, and the regulating mechanism within the cylinder, although single, is so arranged as to operate two sets of carbon holders, changing the electric current, automatically, from one to the other, when required. The especial purpose of these lamps is to supply light all night. The instant one set of carbons is consumed, the second set is automatically ignited, without any cessation or diminution of light, thus burning an average of sixteen hours continuously. These lamps can be used either for single lights, or for serial lights, placing any number in a circuit, and may be operated in connection with single or focusing lamps, or both, as may be desired.



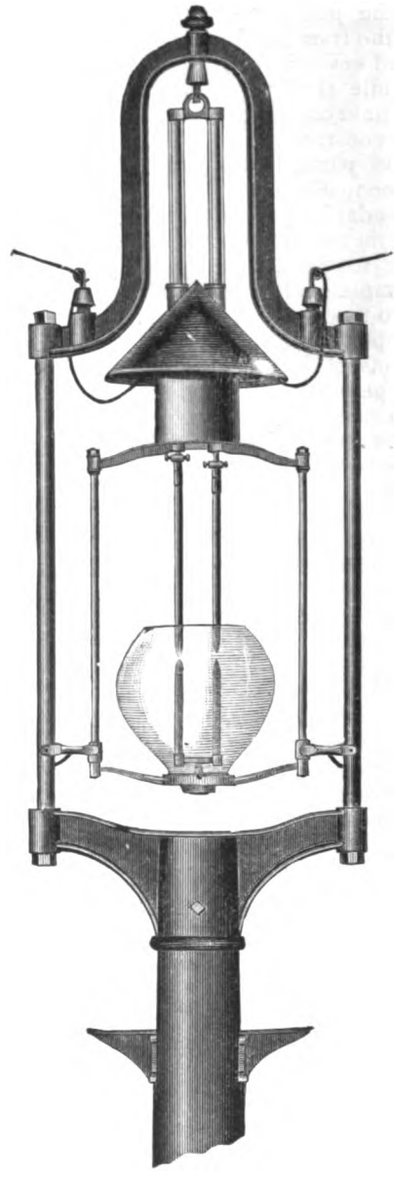
FOCUSING LAMP.



ORNAMENTAL LAMP.

The Focusing Lamp is constructed so as to maintain the burning point of the carbons always in the same focus. It is especially designed to be used with a reflector or projector, and is found very useful on ocean, lake and river steamers, wharves, or wherever great illuminating power is desired. It is arranged, by an ingenious device peculiar to itself, and quite unlike all other focusing lamps, so as to feed both carbons with a positive motion. The base of the lamp is provided with a simple form of adjustment, for use in case either of the carbons should burn faster than its proper proportion, enabling the focus to be always easily and accurately maintained. This lamp operates perfectly in series, with either single or duplex lamps, or both.

The Ornamental Lamp, in its mechanical and electrical features is the same as the standard lamps, but it is made of polished gold bronze, and is especially adapted for stores, saloons, parlors, dining halls, or wherever the plainness of the ordinary lamps is objectionable. Its peculiar design is exclusively the property of the company.



STREET LAMP.

The Street Lamp comprises the standard duplex lamp, set in a frame, and adapting it to the purposes of street lighting. The lamp is insulated from the frame, and protected from the weather, and burns for sixteen hours. The frame is made of wrought and cast iron, combining strength and lightness, and is so designed as to obstruct the light as little as possible. The lamp is reached, for the purpose of replacing carbons, &c., by means of steps, the lowest of

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which is intended to be about seven feet above the sidewalk.

An Automatic Cut-out is attached to all lamps manufactured by The Fuller Company, by means of which, in case of the defective operation of a lamp, by accident or otherwise, or in case the carbons in one or more lamps are burned out before the others in the same series, the defective lamps are instantly cut-out of circuit, automatically, without extinguishing or injuring the other lamps in the same series. All lamps made by The Fuller Company are also provided with a hand-switch, in addition to the automatic cut-out, for cutting the light out of a circuit when replacing carbons, or in case the light is not required. Special attention is given to safety in the construction of all lamps, the line wires being introduced on the upper portion of the frame, thus rendering the wires less liable to damage, and enabling the attendant, should he have occasion to handle the lamp, while the circuit is in operation, to do so without danger of accidental shock. The machinery used in the construction of these lamps is interchangeable in its various parts, so that any part can be immediately supplied when called for.

The standard lights of this company are 2,000 candle-power, but they manufacture those of greater illuminating power when required.

The complete adaptability of the current produced by the dynamo machines to the lamps manufactured by The Fuller Company, and the perfect working of each of the several forms of lamps, have been arrived at by a long series of experiments, occupying much time, and requiring the expenditure of large sums of money. These experiments have been chiefly conducted by, or under the direction of, Mr. James J. Wood, the electrician of the company, who, in addition to being a natural genius, both in mechanics and electrical science, was the first and ablest of Mr. Fuller's assistants. He has been a thorough student in this particular field of research, and a painstaking and exhaustive experimenter; and he, as well as the company, which has employed him since the death of Mr. Fuller in 1879, is to be congratulated upon the excellence of the results attained.

The system of The Fuller Electrical Company is used largely, we are informed, in Chicago and many towns in the West. In this vicinity, it is employed at Lord & Taylor's, cor. Grand and Chrystie Sts., and at Broadway and Twentieth St.; also at Jersey Steel Company, Jersey City, N. J.; Baldwin's Locomotive Works, Philadelphia, Pa.; Washburn Iron Co., Worcester, Mass.; Powers Block, Rochester, N. Y., and many other establishments throughout the country.

—— AN EXTRAORDINARY electric storm, extending throughout the country, occurred on the 17th of Nov. The *Post* of the 18th of Nov., in referring to it, says: Various experiments were tried by telegraphers during the prevalence of the storm to work the wires and dispose of the great accumulation of business, but with little success until it was discovered, that by taking two wires from the ground, between any two given points, and joining their ends, a circuit was formed that could be operated. In this way eight wires between Buffalo and Chicago were made to do service as four. Electricians seem to agree that the disturbance was unlike any heretofore experienced, as it appeared to act upon the wires in strong waves, causing constant changing of the polarity of the current. At Omaha, last evening, the aurora was very brilliant, the illumination rendering the night almost as bright as day. At St. Paul the sky was of blood red color, the display being grand and fearful. Cheyenne reports the illumination at that point, last night, as bright as day. At Denver the display in the northern heavens was most brilliant and dazzling. In California the aurora was visible last night from the northern part of the State as far south as San Diego, and was most brilliant. At Olympia, Washington Territory, the aurora last night was magnificent, the heavens, north and east, being brilliantly illuminated. The Atlantic cables are still effected by the storm, and there will be more or less delay to cable business throughout the day. The trouble, however, is by no means so serious as yesterday. The weather is generally cloudy, while at Boston it is snowing.

THE GOLD AND STOCK TELEGRAPH COMPANY.

THIS company is now a department of the Western Union Telegraph Company, the latter having leased all the lines and property of the first named corporation, guaranteeing to its shareholders dividends of 6 per cent. per annum, and to the bond holders, 7 per cent. per annum. The business of the Gold and Stock Telegraph Company consists in collecting quotations of stocks, bonds, cotton, produce, petroleum, and other commodities, from the exchanges in all parts of the world, and furnishing the same to its subscribers, wherever located. As the business of distribution carried on in other cities within the United States, is precisely the same as that used in New York City, being simply a duplication of it on a smaller scale, a description of the New York system will be understood as applying to other cities. There is one important difference, however, to be noted, which is, that while in New York the bulk of the news furnished to the subscribers consists of quotations collected from the respective exchanges in New York City, that of the branches (as the outside cities are called), is principally transmitted from New York City on Western Union wires. Thus the company has two profitable markets for its news—one in New York City, and the other the whole commercial world outside of New York.

The largest and most important part of the New York system is represented in the *stock* instruments. The company employ reporters, who are also Morse operators, whose duty it is to mingle with the brokers in the "pools," as the groups of brokers dealing in a certain stock are called, in the Stock Exchange, while the Board is in session. As fast as sales are made by the brokers, the reporters telegraph them on Morse wires to the Western Union building, where an operator is constantly in attendance to receive them. In the Operating Room in the Western Union building, the Morse operator who receives the quotations, sits close beside the transmitting operator who works the printing instruments. As the Morse receiver writes the quotations down on slips of paper, the printing operator reads them and transmits them on the printing instruments simultaneously with their receipt. Two Morse wires are provided, and are always ready for use, and equipped with a duplicate set of instruments, so that when one wire is interrupted, the other is put into immediate use, thus avoiding delays. The transmitting apparatus consists of a revolving cylinder having thirty pins arranged in two semi-spirals on its circumference, driven by an electric motor, and controlled by thirty finger keys, colored alternately white and black, and shaped like those of a piano. At one end of the cylinder are placed two ratchet wheels, one with fifteen teeth, and the other with thirty. The wheel with fifteen teeth operates a vibrating-arm, pushing it against a fixed platinum stud, when a tooth of the wheel touches it, and allowing a retracting spring to withdraw it from the stud when the tooth passes it. When the cylinder is in motion this vibrating-arm opens and closes a local circuit, to be hereafter described, and when the cylinder is stopped, by depressing a key, the vibrating-arm is stopped either resting against the stud, or withdrawn from it, according to the position of the pin engaging on the key which is depressed. The relations between the keys, pins, vibrating-arm and stud, are such, that the depression of alternate keys retain the arm against the stud, and the remaining keys, when depressed, stop the wheel at points where the arm is withdrawn from the stud. The function of the 30-toothed wheel is to govern another vibrating-arm which closes a separate local circuit, to be hereafter described. When the cylinder revolves, the vibrating-arm is prevented by the rapid motion of the toothed wheel, operating on a pawl

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on the end of the arm, from falling into the spaces between the teeth of the wheel, but when the cylinder is stopped by the depression of one of the keys, the arm falls into a notch between two of the teeth. This vibrating-arm is pivoted at its centre, and the end, which is farthest from the wheel, closes the local circuit by pressing against a platinum contact spring. The first named local circuit is called the *type* circuit, because it operates the type relays, and the latter the *press* circuit, because it governs the printing relays. The transmitter has attached to it a lever which extends throughout the whole breadth of the key-board, which, when depressed, simply opens the press local circuit, thus enabling the operator to repeat the last character that has been printed, without revolving the type wheels of the instrument, to bring the same character opposite to the printing pad, the second time.

The type relay local circuit contains two separate sets of relays, each set being on a separate wire, the first set being used to operate the letter type wheels of the printing instruments, and the second set to operate the figure type wheels. Another and separate set of relays are used to operate the printing presses of the instruments. The 15-toothed wheel of the transmitter operates either the letter relays or the figure relays, as the current may be directed by the operator, who turns a switch which directs the pulsations produced by the vibrations of the vibrating-arm into one or the other of these two circuits, at will; while the 30-toothed wheel of the transmitter, and the repeat-key, above described, operate the press relays. The magnets of the relays are in the local circuits as described, while their platinum contact-points are connected to the main batteries, and main lines of the circuits to be operated, respectively.

Each main circuit consists of three line wires, and the printing instruments are placed in circuit on these three line wires, and each circuit requires three relays to operate it. The main battery, a separate one being used for each circuit, is connected by branch wires to the armature levers of all three of the relays used to operate one circuit, while the three separate line wires are connected to the front platinum contacts of the three relays separately. The printing instruments, which receive and record the quotations as sent out, consist of three separate parts, and require three separate line wires to perform their functions. One line wire passes through an electro-magnet, which operates on an armature lever, having an anchor at its extreme end, so placed in relation to a 15-toothed wheel, that when the armature is attracted by the magnet the anchor moves downward, strikes against the edge of one of the teeth in the wheel, and moves the latter forward a certain distance, limited by the depth of the notch in the wheel between two adjacent teeth. When the current is withdrawn from the wire, and the magnet loses its attractive power on the armature, an adjustable retracting spring forces the armature upward, and then the lower pallet of the anchor strikes against the nearest side of the opposite tooth in the escape wheel and forces the latter forward one more tooth. By this means the escape wheel may be revolved step by step, indefinitely, and stopped at any position desired. It must be understood, that both the escape wheels of the instruments, and the revolving 15-toothed wheel of the transmitter, start from the same fixed point, called the "unison dot," and, therefore, when the vibrating-arm of the transmitter makes one complete excursion, closing the local circuit and opening it again, once, the escape wheels of all the instruments make two forward movements, one when the circuit is closed, and another when the circuit is opened again. All of the printing instruments have, rigidly fixed on the same revolving shaft which carries the escape wheel, a letter type wheel, on the periphery of which is engraved 30 characters, consisting of all of the letters of the English alphabet, the sign "&" and three punctuation marks. The position of the type wheel on the shaft, in relation to the escape wheel, is such, that, starting from the unison dot, the first downward movement of the letter wire armature brings the letter *A* opposite to the printing pad, and the next upward movement brings the letter *B* in the same position, and so on through the alphabet, so that 15 closings of the local and main circuits suffice to bring 30 letters successively into position to be printed if desired.

(To be continued.)

THE WESTON CARBON FOR INCANDESCENT LAMPS.

THE great desideratum for lighting by the incandescent system has been a more perfect form of carbon. With the extremely attenuated form assumed by the luminous conductor in the modern incandescent lamp, serious difficulties, both mechanical and electrical, have been encountered, which render the use of ordinary forms of carbon impracticable. They are too fragile to endure the necessary manipulations of manufacturing, and the mechanical shocks incident to transportation and use; and very great difficulty has been experienced in securing the extreme uniformity of calibre and density requisite for producing the same degree of incandescence throughout the whole length of the conductor. Inventors have, as we think, wisely, given much attention to devising methods for producing better forms of carbon. It has been proposed to use processes analogous to those adopted for making pencils for arc lamps, in which pulverized gas-retort carbon, or graphite, is mixed with some binding material, such as syrup, tar, or asphalt, and the semi-plastic material thus formed, is molded into shape and carbonized; but the results so far obtained by these processes have not been encouraging, on account of the comparatively brittle and porous nature of the carbon so formed. Even solid blocks of gas retort carbon, or graphite, are found to have a marked granular structure when examined under a sufficiently powerful microscope, and this is exaggerated in carbon formed by the processes we have mentioned, the grains or particles of the powder being merely cemented together by the carbon residuum left from the binding material.

Better results have been obtained by carbonizing blanks of some fibrous vegetable substance, such as paper, wood, or textile material. In the conductors formed by this method, however, the original structure of the material is preserved with great fidelity; and, although they are much more flexible and of higher specific resistance, the fibrous or cellular structure of the carbon considerably impairs its density, and the interstices between the fibres, especially when the fibres are not disposed in the direction of the length of the conductor, are apt to lead to the formation of minute arcs, which soon disintegrate the carbon and destroy it. Considerable difficulties have also been experienced in securing sufficient uniformity of quality in the material, and in working it into shape with sufficient accuracy. In two of the most successful of the incandescent lamps, the fibrous structure of the carbon has been somewhat modified. In the Maxim lamp, although the basis of the carbon is structural in character, the subsequent treatment with hydro-carbon vapor, fills up, in a great measure, the interstices between the fibres, and partially obliterates the structure. In the Swan carbon, the structure is partially broken down by the process known as parchmentization before the material is carbonized. This obliteration of the structure, is in both cases only partial; and the Maxim method appears to be preferable, as the treatment is so applied as to correct such inequalities of resis-

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tance as there may be in different parts of the conductor. In view of the advantages secured by this partial obliteration of structure, Mr. Weston was led to believe, that still better results would be obtained if a carbon could be produced which should be entirely structureless. A high specific resistance is obviously very desirable; and, as carbons of vegetable origin appear to be of much higher specific resistance than those of inorganic origin, he directed his efforts to obtaining an entirely amorphous or structureless material of vegetable origin, out of which to form the carbon. This he has accomplished by entirely breaking down or obliterating the structure of cellulose, and re-aggregating it in an amorphous form, but in such a way, as to secure a very high degree of toughness and elasticity. The first method, which he used for this purpose, was to dissolve cellulose in ordinary form, such as cotton, linen, or paper, with cupra ammonium, sulphuric acid, some other efficient solvent, and thus obtain a gelatinous substance, which could be formed into sheets or strips,and afterward carbonized. The substance thus obtained possess nearly the same chemical characteristics as cellulose in the original form, but is amorphous, or without fibrous or cellular structure, and homogeneous. It is opaque and somewhat pliable, and the carbons formed from it, although homogeneous in structure, and much less brittle than carbons formed fron inorganic substances, are not generally as elastic or strong as the carbons of the fibrous class. Very much better results were obtained by a somewhat different process, which he afterward adopted. Cellulose, in any of the ordinary fibrous forms, is subjected to the action of a mixture of nitric and sulphuric acid, in the same manner as in the ordinary processes for making pyroxyline, gun-cotton, or nitro-cellulose, and this, when dissolved in a mixture of ether and alcohol, produces collodion, or by treating it with various other solvents—such as nitro benzole, naptha, or camphor, the ordinary celluloid is produced. Both collodion and celluloid may be shaped with great facility, into any desired form, but so long as the characteristics of nitro-cellulose remain, they are not fit for the production of carbons, for the reason that they burn without any considerable residue even in a vacuum, and accordingly will not carbonize. In order to render them suitable for this purpose, they are de-oxidized by treating them with such chemical agents as will deprive their nitrous qualities, and bring them back to the chemical constitution of cellulose. The best of such reducing agents are, ammonium sulphydrate, protochloride of iron, and sulphate of iron. In practice, the celluloid or collodion is formed into thin sheets of somewhat greater thickness than that desired for the carbon conductors, and the sheets so formed, are immersed in a solution of one of the de-oxidizing agents, and allowed to remain in it until they are entirely re-converted to the original chemical condition of the cellulose. The product obtained by this process may be termed amorphous cellulose, and resembles closely, in many respects, ordinary celluloid, but differs greatly from it in others. When properly prepared, it is almost entirely transparent, having only a slight amber tinge, is very tenacious and flexible, and may be readily carbonized in the ordinary manner, but the heat employed has to be somewhat greater than with ordinary fibrous materials. It is apparently entirely homogenous, and, when examined under a microscope of very high power, it shows no structure. On account of its toughness and the ease with which it can be shaped into any desired form, either by moulding during the process of manufacture, or by working with tools, or dies, after the process is completed, it will probably prove of great value for other uses than as a basis for electrical carbons; but for this use at least, it appears to be the best material which has yet been devised. In making carbons from it, blanks or strips are cut or stamped out of sheets in the ordinary manner, and these are afterward placed in a retort and carbonized in the usual way. The material seems to work with dies and tools very much like a metal, and the outline of the blanks formed with dies is sharp and clear. The carbon resulting from the carbonization of this material is quite remarkable in its characteristics. It is apparently entirely homogeneous and amorphous; and although the density of the carbon appears to be very great, its specific resistance is considerably higher than that of carbons prepared from fibrous materials, or those procured from inorganic substances. Owing to the great facility with which very thin sheets can be worked, and narrow blanks cut out of them, while still preserving great accuracy of mechanical work, conductors may be made of enormously high resistance. There appears to be no difficulty in making such conductors of three or four thousand ohms resistance which show no unevenness of heating whatever under the influence of the current, and in securing sufficient uniformity of mass and resistance in the different conductors to dispense with subsequent treatment for standardizing. In appearance, a carbon conductor made by this process, closely resembles a fine steel spring, only the color is a lustrous black, and its elasticity and toughness are very remarkable. Conductors of ordinary size may be readily rolled into a spiral, about an ordinary lead-pencil, without breaking, and, when released, spring back immediately to their original form. With a conductor mounted in a lamp, it seems to be absolutely impossible to break it by any mechanical shock or jar, even when the globe is shaken so as to cause the carbon to touch first one side of the globe, and then the other. The extremely smooth and polished surface obtained, appears to be an important advantage, as it materially reduces the attrition of any residual gases upon the surface of the conductor, and probably lessens the occlusion or adherence of air or gases. Although incandescent lamps, having conductors made by this method, have not yet been for a sufficiently long time in use to give precise results in regard to durability, we have no doubt that this form of carbon will prove far superior, in this respect, to any other now in use; and we consider this an important contribution to the development of the incandescent system, especially if (as now seems probable) economy of distribution from large centres is to depend largely upon the production of efficient lamps of higher resistance than those now in use.

—— A CORRESPONDENT from Pike's Peak, writes under date of Oct. 25th: Many who have strong lungs remain purposely all night to witness the electric and stellar sights, which are sometimes very fine. One night last summer an electric storm came on, which, from the description given me by Officer Leitzell, must have been very grand. For two days previously thunderstorms had been rolling among the mountains, and then for over two hours everything was tipped and covered with electricity. Spanish pack-mules, left on the summit for the night, appeared to be all on fire; the clothes of the men seemed ablaze; electricity streamed from the tips of the fingers, from the nose, and from the hair. The anemometer, on top of the building, spat fire at every revolution. Every rock on the summit was covered with flame.

—— THE GRAMME ELECTRICAL COMPANY have recently published a pamphlet, notifying all parties manufacturing or employing apparatus to obtain light or power, or to plate by electricity, that the existing letters patent of the United States, owned and controlled by the following members of the organization, viz.: The American Electric Company of New Britain, Conn., The Brush Electric Company of Cleveland, Ohio, The Edison Electric Light Company of New York, The Fuller Electrical Company of New York, The Jablochkoff Electric Lighting Company of New York, The United States Electric Lighting Company of New York, and The Weston Electric Light Company of New Jersey, will be enforced against all parties infringing the same. The pamphlet contains a list of the patents referred to, with date of issue.

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THE MUNICH ELECTRICAL EXHIBITION.

THE progress of electric science is now so rapid that exhibitions of late improvements have a *raison d'être* that no other industry can lay claim to. The Paris and London exhibitions have been followed by that of Munich, which, although anything but complete, still afforded an opportunity to judge of some of the more recent advances in electro-technology.

On the occasion of its opening, Prof. Von Beetz delivered an address, which was, essentially, a rapid survey of the successive discoveries in the science, until now "the motive power furnished by water, by steam engines and gas machines will be used by dynamo-electric machines, and electricity can be put in action at will, and at a given moment. A circuit, traversed by a current, is heated to a glow, and the hundreds of carbon filaments of incandescent lamps and the powerful foci of arc lights, furnish us with the very light of day itself."

The exhibition was held in the "Glass Palace" of Munich, and a magical sea of light surrounded the trees and statues of the garden. The reports in the German papers state that the incandescent lamps of Riedinger and Siemens are not very satisfactory, neither are the differential lamps of the latter. In the former lamp the light is intermittent and insufficient.

The most interesting part of the Exhibition, for electricians, was that containing the dynamo-electric machines for illuminating and motive power—of which no fewer than 56 were exhibited—representing fourteen different systems. One of the machines was located at Hirschau—a distance of five kilometres. It makes 800 revolutions, and using twelve horse-power delivers a current of 660 volts tension, and 8 ampere force. The loss in force is estimated at 60 per cent., but the machine is a very fine example of the transmission of power with the simultaneous use of the current for various purposes.

Deprez has also a transmission for long distances; he uses two Gramme machines, which are enveloped with very thin wires. One of the machines was at Miesbach—a distance of 75 kilometres. Two ordinary telegraph wires were used for the transmission. It made 2,200 revolutions, required 2½ horse-power, and gave a current of 2,300 volts tension. The employment of such a high degree of tension has been characterized as dangerous, as no insulation could permanently withstand it.

The Edison lamps, exhibited by the "Paris Edison Co.," were found to work satisfactorily, and the illumination of the Arcis Strasse, from the Glass Palace, to the Brienner Strasse, by the Edison lamps, the German papers state, was satisfactory, but the effect was, on the whole, that of a good, steady gas lighting.

The illumination by the Brush system was defective, but the Brush Company has promptly disavowed the Vienna firm which undertook the installation.

So far as inventions and improvements in the telegraph and telephone are concerned, it is seen that the State system has a most paralyzing effect, by the difficulty with which any innovation can be brought to the notice of Government officials. The Paterson instrument is the one most in favor, and is very satisfactory in dry weather, but otherwise, when insulation is made imperfect through humidity.

The Munich Clinical Institution has paid great attention to the use of electricity for therapeutic purposes, under the supervision of the celebrated Prof. Ziemssen. These experiments are mostly designed for the better inspection of the internal organs, and will, no doubt, have a great influence on the better diagnosis of disease, and knowledge of the animal functions.

POLYTECHNIC SOCIETY OF THE AMERICAN INSTITUTE.

ON Thursday, November 9th, the usual weekly meeting of the Polytechnic Society of the American Institute, Prof. T. S. Stetson in the Chair; was called to order at 8 P. M., and the members first concluded a discussion of ventilation, which was continued over from the previous meeting. At 8.30, the President announced that the regular subject for the evening's debate would be Incandescence, and invited Dr. Van der Wyde to address the meeting upon the subject. In an informal manner the Doctor entered into a general review of the subject, and stated that the first incandescent electric light was exhibited before the Royal Polytechnic Association, by Sir Humphrey Davy. He then discussed the various methods of developing heat and light, and explained that heat could be produced simply by percussion. He had seen a blacksmith hammer a bar of iron until it was red hot; rifle bullets striking a target may be melted by the heat of percussion; cannon balls emit a flash of light when they strike a resisting object; by the impact of meteors projected into the sun, its heat is sustained. In all these cases motion is converted directly into heat, but it may be first converted into electricity, and then into heat, in accordance with the law of the correlation of forces. Thus, the motion of the armature of a dynamo-electric machine develops electricity, which may be carried through suitable conducting wires without heating them; but, if at any point a portion of the conductor is made too small, or of a poorer conducting material, that portion will become red hot, and emit light. Platinum wire is a poor conductor, and when it forms part of such a circuit, becomes red hot. Attempts were made to make incandescent lamps for illuminating purposes in this way, but for various reasons they did not succeed very well. A thin strip of carbon, however, in a vacuum to protect it from contact with oxygen, which would consume it, is successfully used. Carbon is best adapted because of its high resistance to the electric current, whereby it takes less electricity to become heated than any other substance, and its capability of enduring the highest temperature without melting. The light given out depends on the temperature. At 1500°, a solid object, such as a wire, becomes red-white hot; at 2000°, yellow-white hot; above 2000°, blue-white hot. He had seen a Maxim incandescent lamp reach a temperature of 2000°. In order to do this the carbon strip must be of a suitable solid texture. This is produced in the Maxim lamps by heating a strip made from any material in a hydro-carbon vapor, whereby carbon is deposited first in its pores and then in layers on its surface, causing it to gradually thicken. The carbon deposited upon such a strip is seen under the microscope to be exquisitely crystaline, and it forms a very compact material, precisely suited for the purpose, A very fine platinum wire may be thus heated in the hydro-carbon vapor, and become the nucleus of a carbon strip An attempt was once made to light the entrance of the Fourth Avenue tunnel at Forty-second Street by means of a large incandescent lamp, but it was soon abandoned. It may be said, however, that in a certain sense all electric lamps are incandescent lamps. In the arc lamp the light is produced by the heating of little particles of carbon which are projected from one point to the other. An arc lamp when working properly, is perfectly steady. The usual flickering is caused only by the operation of the regulating contrivance. Of all arc lamps the Brush lamp is the best. At the conclusion of his remarks, Mr. R. d Heureuse arose, and said that even when an arc lamp is burning steadily, the light appeared to him to waver or constantly vary. He thought the effect he referred to was due to variations in the number of carbon particles transmitted through the arc at each instant. He thought it must injure the eyes. Though his point appeared well taken, it was not admitted by the Doctor, who persistently attributed the only wavering possible to the mechanism of the lamp.

These meetings are free to the public, occur every Thursday, in the Cooper Union, Room No. 24, and all are invited to attend. A different subject is discussed each time.

—— SINCE WE LAST went to press, and on the morning of Oct. 28th, T. Kelly, of 2297 Fourth Avenue, was found dead in his bed. The gas in his room was turned on, but not burning.

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SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

NO. VI—THE CYLINDER ELECTRICAL MACHINE.

ABOUT the middle of last century the globe electrical machine was extensively in use in England, France, Germany, Italy, and America, and while the Abbe Nollet, the most prominent experimenter in France, persistently adhered to the use of the naked hand only for exciting it,[1] and, together with a few others, equally conservative, obstinately resisted innovations in its management, a host of more enterprising investigators were endeavoring to further improve it.

Founded upon no scientific basis, their projected improvements were largely chimerical, and, when rescued from oblivion, excite our curiosity only; but some among them led to developments of great importance. The first of these arose from efforts to use the cushion of Winckler,[2]

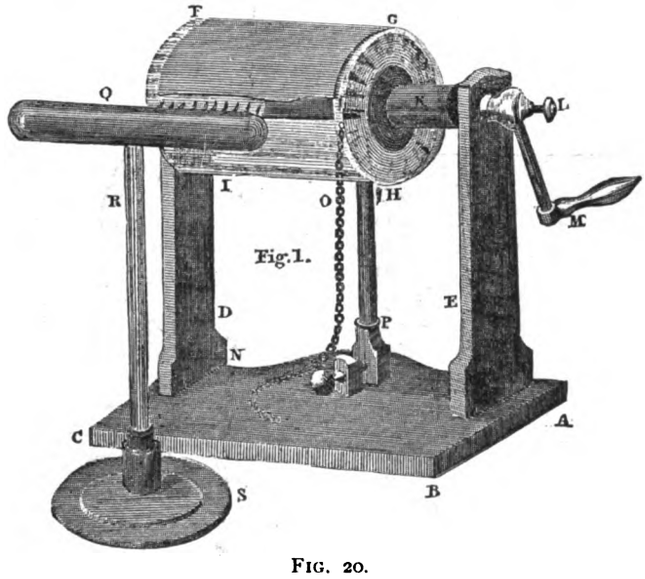

FIG. 20.

which, though favored by the majority of experimenters, was, for two reasons, difficult to adapt to the globe. The globular form was unfavorable, and the globes, then procurable, were very irregular in contour. These difficulties had already led several among the Germans to prefer the spheroid, either oblate or prolate, and even to employ the elipsoidal form for the electric;[3] when Andreas Gordon, a Scottish Benedictine monk, Professor of Philosophy at Erfurt, who was born in 1712, and died in 1751, abandoned the curved form altogether in 1735, and adopted a straight cylinder of glass instead.[4] The cylinders he used were 8 inches long, by 4 inches in diameter,[5] and by this modification, which was not very rapidly accepted, it was, for two reasons, found possible to use the cushion more successfully. These were, first, that a long cylinder and cushion gave a larger area of rubbed surface; and, second, the cylinders, then procurable, were much more regular in size and shape, than the globes, and the cushion, depending for adjustment solely upon the elasticity of its leather cover, pressed more uniformly against the glass.

1. Because, says M. Sigaud de La Fond, his hands were remarkably efficacious, and succeeded when those of others failed. Precis, 1768.
2. See Third Sketch.
3. Nollet, F. A. Essai sur l'electricite des corps. A. La Haye, 1747.
4. Lardner, Cat. Encyc. London, 1841, p. 17.
5. Phenomena electricitatis exposita, ab Andreas Gordon, 1735.

The globe developed electricity so slowly, that it gave large sparks only when associated with a large prime conductor, upon which the electricity could accumulate; and Mr. Benjamin Franklin, who long continued to use, in America, a simple globe and crank, says, in a letter written in 1752: [6] "I have a large prime conductor, made of several sheets of clothiers' pasteboard, formed into a tube, near ten feet long, and one foot in diameter. It is covered with Dutch embossed paper, almost totally gilt. This large metallic surface supports a much greater electrical atmosphere than a rod of iron of fifty times its weight will do, and, when charged, will strike at near two inches of distance."

With a cylinder, the electricity was more rapidly produced, and so a large conductor was unnecessary.

An electrical machine then consisted of three essential features. First, a rubber, or cushion; second, a globe, or cylinder; and, third, a prime conductor. The latter of these, thus already reduced in size, was destined to be next again improved.

Mr. (afterward Sir William) Watson, a Fellow of the Royal Society, and a gentleman of wealth, became an infatuated experimenter, and while he was most conspicuously generous in encouraging the labors of others, however unpretending, by bringing their results before the Royal Society, and conscientiously credited the least item to its true originator, he described his own experiments in three letters to the society. These were afterward largely circulated, in the form of a book, in one edition of which—illustrated by most beautiful and costly engravings—his electrical machine is shown.[7] It consists of four glass globes, mounted one above the other, and turned horizontally by belts, which run in grooves, side by side, on a large driving wheel. Either of these belts may be thrown off at pleasure, and any number of the globes used, as may be desired. The electricity is produced by Winckler cushions, or pads, fixed upon an upright post, and expressly described as depending only upon the elasticity of their leather covers to adjust themselves to the inequalities of the glass globes; but the interesting feature of the machine is a novel prime conductor, the origin and construction of which Mr. Watson explains as follows:—

"While electrified conductors lose at once all their electric virtue when touched, electrics, or non-conductors, are relieved of it only from a small space, or area, around the point of contact, as if they were made up of sections, each of which throws off its electricity by a different explosion. * * * * * It is desirable to collect, as far as possible, the whole mass of the electric fire at the same instant, and Professor Holman, of Gottingen, who has especially endeavored to effect this object, seems to have accomplished it successfully. He uses, for a prime conductor, a tin tube, and inserts in one end of it a mass of threads, which hang down in contact with the revolving globe. Each thread collects a proportion of the electric fire, which all accumulates in the tin tube."[8]

This brush of threads soon gave place to a brush of fine wire, which seems to have been first mentioned, if not devised, in 1752, by Benjamin Wilson, F.R.S., who, in one of his works, gives a picture, and the details of a cylinder machine, with which his experiments were made, and also explicitly describes the cushion as being pressed against the cylinder by a screw only.[9] His cylinders were 5 inches in diameter and 12 inches long. As to the several circumstances that are necessary to be observed regarding an

6. In a letter dated 1752. Franklin's Works, by Jared Sparks. Boston, 1856. Letters, Vol. 5, p. 234.
7. Experiences, observations, &c. Three letters on electricity, by William Watson. Translated from the English of the second edition. Paris, 1748. Plate 1, fig. 1. Also in Philosophical Transactions, 1747, p. 717. Splendid cut.
8. Ibid, p. 712.
9. Electrical experiments, by Benjamin Wilson. London, 1752.

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electrical machine, he says: "First, we make use of a cylinder, and that a cylinder is the most proper figure for this purpose will be hereafter confirmed by reason and experiment."[10]

Mr. Wilson then proceeds with a long numbered series of directions regarding the management of his electrical machine, and, in the eleventh of these, he refers to the above mentioned brush of fine wires terminating the prime conductor, which is its important feature, as follows: "The cylinder must turn towards the points of the wires and not from them. Those points must hang close to the glass, and about three and one-half or four inches from the cushion."

For some time it had been customary to assist the cushion by holding the naked hand, or applying, occasionally, a little piece of leather upon the glass beyond it.[11] Mr. Wilson's list of directions, which is so complete that it might serve to direct the management of a machine to-day, is further remarkable for a probably first reference, to what afterward became the fourth appendage, of the friction electrical machine in every form, now familiarly known as the curtain.

In No. 8, he says: "There must be a piece of clean, smooth leather (red was what I made use of), of a considerable length, and as broad as the cushion is long, to be applied between the cushion and the cylinder, with the smooth side next the glass. If the smooth side be gilt, or covered over with silver, brass, or copper, it will do full as well."

The curtain was seized upon as an advantageous addition to the cushion, though silk was soon discovered to be a better material for it than leather, but its metal coating was transferred to the cushion itself, by Mr. John Canton, in 1753,[12] who applied it in the form of an amalgam of mercury, with other metals, which immediately superseded all substances previously employed, and, though of questionable utility, has been resorted to ever since.

But, despite these improvements, the use of the cushion was still attended with vexatious difficulties, until M. Sigaud de La Fond, in 1754, contrived the now common combination with it of an adjustible spring, to adapt it to his globe machine, and thus rendered it equally available for all. An illustration of his crude contrivance is the most important figure in his historical work.[13] An idea of it is given in Fig. 21.

The cylinder machine, provided with Wilson's wire brush, prime conductor, and curtain, Canton's amalgam, and the adjustible cushion of de La Fond, now approached its full development, and rapidly superseded the globe, and its prevalence, a few years later, is attested by Mr. Benjamin Franklin, who, in a list of articles purchased by him in London, in April, 1758, to be sent to Professor Winthrop, of Harvard College, includes "a large glass cylinder, mounted on an iron axis, with brass caps," because, he says, "this form is most used here, and thought better than the globe."[14]

It having become a common practice to construct the prime conductor of a hollow tube with round or spherical ends, a further and final improvement was made in it, which consisted in substituting a row of sharp metal points for the brush of threads, and brought this feature of the machine to a degree of perfection, beyond which, it has not been since improved. Fig. 20 is from a copper-plate engraving, published in 1793, representing the usual cylinder

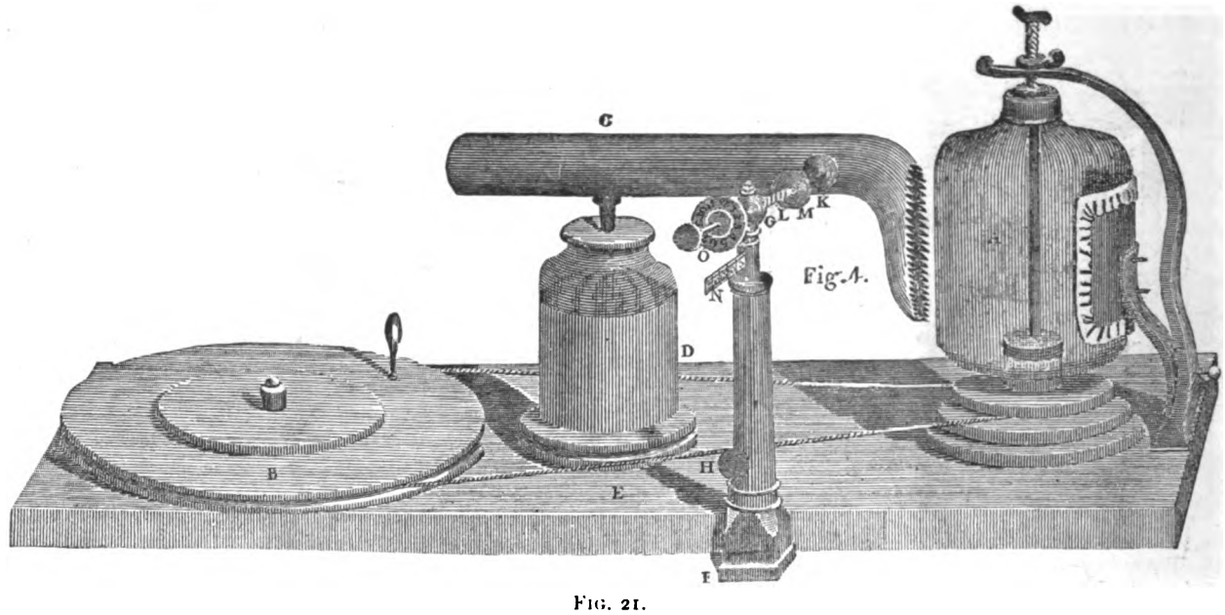

FIG. 21.

electrical machine of an earlier date. Fig. 21 shows an odd machine of the same period.

Long before this time, Mr. William Watson discovered the source of electricity in the electrical machine; and insisted upon the necessity of connecting the cushions with the ground. He shows that the machine apparently draws in electricity through the ground connection, and forces it out by the prime conductor, and having imagined a theory of electricity, which assumed it to be a highly imponderable material substance that he called "electric ether," he compares the action of the globe to that of a water pump; or the human heart, which draws in the blood on one side that it pumps out on the other, and he considers the action of the glass tube to be similar. "Since, therefore, the globe machine is simply a pump, and pumps the electric ether, which is a kind of fire," Watson asks, "Why is it not as reasonable to call it a 'fire pump' as to call the new machine of Guericke and Boyle an air-pump?"[15]

10. Ibid.
11. Nicholson's Philosophy. Philadelphia, 1793, Vol. 2, p. 342.
12. Lardner, Cat. Encyc. London, 1841, p. 69.
13. M. Sigaud de La Fond. Precis Historique, &c. Paris, 1781.
14. Franklin's Works, by Jared Sparks, Boston, 1856. Letters, Vol. 5, p 361.
15. Watson, William. Loc cited; also Philosophical Transactions, 1747. No. 484, p. 728.

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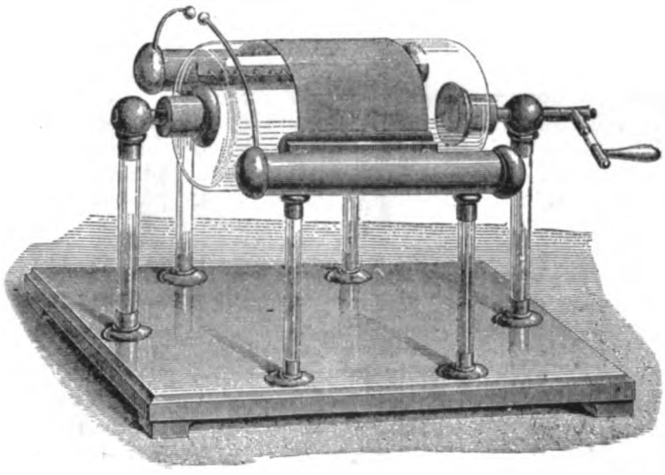
In a letter, dated about the same time, Franklin says: "Place a thick piece of glass under the rubbing cushion, to cut off the communication of electrical fire from the floor to the cushion; then if there be no fine points or hairy threads sticking out from the cushion, or from the parts of the machine opposite the cushion (of which you must be very careful), you can get but a few sparks from the prime conductor, which are all the cushion will part with."[16]

A short time later, in a letter to James Bowdoin (dated January 24, 1752), he refers to the same matter again, saying: "My globe raises the electric fire with greater ease, and in much greater quantities, by means of a wire extended from the cushion to the iron pin of a pump handle behind my house, which communicates by the pump spear with the water in the well."[17]

When experimenters appreciated the reason why a good ground connection with the cushion was necessary—when they understood that the electric impulse, indicated by a spark entering the finger from the prime conductor, passed through the subject's body to the earth, and through the earth connection chain to the cushion, it became evident that, by standing on a glass legged stool, and placing one hand on the cushion, most powerful sparks could be taken from the prime conductor. This led to the discovery that



F.G. 22.

for a quantity of one kind of electricity furnished by the prime conductor, the cushions would supply an equal quantity of the opposite kind, and an appreciation of this fact led to the production, in 1783, of Nairns' patent perfected cylinder machine, which is represented in Fig. 22, and is seen to be provided with two prime conductors. To one of these the cushions are attached, to the other a row of points. If the former be connected with the earth, the latter will supply vitreous electricity. If the latter be connected with the earth, the former will supply resinous electricity. If neither communicate with the earth, they become oppositely electrified. Mr. Nairn, who was a mathematical instrument maker in London, occasionally employed by Mr. Benjamin Franklin,[18] sent him one of these machines, and in a letter of acknowledgment, dated Passy, October 18, 1783, Mr. Franklin says: "I think it very ingeniously contrived, and wish your success in its sale may be equal to its merits."[19] This was probably the most perfect electrical machine that Mr. Franklin, who died in 1790, ever saw.

A Nairn machine, with a cylinder 1 foot long, by 7 inches in diameter, and a large prime conductor, is credited by Nicholson, in 1793,[20] with giving nine-inch sparks.

16. Franklin's Works, by Jared Sparks. Boston, 1856. Letters, Vol. 5, p. 227.
17. Ibid, p. 272.
18. Franklin's Works, by Jared Sparks. Boston, 1856. Letters, Vol. 5, p. 727.
19. Ibid. p. 479.
20. Nicholson's Philosophy. Philadelphia, 1793, Vol. 2, p. 306.

ACTION OF VOLTAIC BATTERIES.

To the Electrician:

IF we take a vessel partly filled with sulphuric acid, and insert in it a plate of zinc, the zinc will be immediately attacked by the acid, sulphate of zinc will be formed and dissolved in the solution.

As this chemical action proceeds, the electricity, naturally belonging to and residing in the plate of zinc, is carried off by the dissolving salts, by a process similar to that by which heat is carried off from a body by water evaporating from its surface. By this action the zinc is deprived of a portion of its electricity; and the solution, taking up the electricity, thrown off from the zinc, becomes overcharged. This charge is prevented from passing back to the zinc by the same force which threw it off. But, if the chemical action continues, this is evidence that electricity is passing back to the zinc in spite of the resistance. This is the case with most batteries. The force which throws it off from the zinc is termed electro-motive force. The tendency which it has to return may be termed electric tension.

Now, if we place in this electrified solution a plate of carbon, it is evident that as the carbon is a conductor, and will not be chemically acted upon by the solution, it will instantly become charged to an equal degree with the solution, and, if connected by a conductor to the zinc, a current of electricity will be established, and if the connection offers little or no resistance, the tendency of the electricity to return to the zinc plate through the solution will be removed, and the chemical action greatly augmented thereby. This is the action of a single voltaic cell.

Let us now consider what will be the effect if two, or more, of these cells be joined together for intensity, as it is called. The carbon or negative plate of the first, connected to the zinc or positive plate of the second, and so on; the positive plate of the first, and the negative plate of the last of the series being left disconnected.

The action begins in the first cell, as above described, but in the second cell, as soon as the zinc is deprived of a portion of its electricity, it is supplied from the overcharge of the solution and negative plate in cell No. 1; and as the electro-motive force, or power of throwing off electricity from the zinc, is equal in both cells, the action in both will continue, until the solution and negative plate in cell No. 2 are charged twice as heavily as the solution and negative plate in cell No. 1.

Let us now analize the condition of the battery at this point, which condition is acquired instantaneously, though the description may be tedious.

The zinc plate of cell No. 1 is minus a portion of the electricity which it originally had. The carbon plate of cell No. 1 and the zinc plate of cell No. 2 are equally charged to a degree corresponding to that described in the case of the single cell. Also, in cell No. 2 there must be as much difference in the electric condition of the two plates as there is in cell No. 1, and as the zinc plate in cell No. 2 is charged equal to the carbon plate of cell No. 1, therefore the solution and carbon plate of cell No. 2 is charged twice as heavily as the solution and carbon plate in cell No. 1. The solution and carbon plate in cell No. 3 would be charged three times as heavily as No. 1, and so on through a series of any number of cells, and if the extreme ends of the battery be joined the current must flow with a corresponding energy.

New York, Nov. 13th. L. J. PHELPS.

—— ON 21ST OF NOV., an unknown man went to the Occidental Hotel and secured a room, registering as James Walker, of Chicago. Next morning he was found unconscious, and his room full of gas.

—— BEATEN ALUMINUM LEAF may be now obtained in books like silver leaf, and is largely used instead of silver leaf for decorative purposes. Mr. Levison suggests heavy aluminum leaf as a substitute for tin foil for coating Leyden jars, and similar electrical apparatus. Area for area, it does not cost much more, is much lighter, and permanently retains its polish. A book of fifty leaves of aluminum, of the ordinary thickness, costs 25 cents; of a thickness suitable for Leyden jars, 50 leaves, about 4 inches square, cost $1.00.

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AN EXCURSION IN A TORPEDO BOAT.

A Visit to the Torpedo School at Boyardville, (Ile D'Oléron).

IT is well known that since the discovery and application of the new explosive materials, marine warfare is undergoing a process of complete transformation ; the age of torpedoes has succeeded to the age of gunpowder. Everything which concerns the study of these formidable engines possesses a powerful scientific, as well as patriotic interest. Notwithstanding the utterances of those well-intentioned, but impracticable persons among us, who dream of the fraternity of people, and the universal alliance of the nations, it is necessary to be strong, if one would hold one's place in the great battle of life. *Si vis pacem para bellum.*

I recently had the good fortune to visit the torpedo school at Boyardville, in the Ile D'Oléron, and to travel from thence by the river Charente, on board of one of the new torpedo boats of our marine. Such an interesting excursion, so extraordinary for a layman, is an occurrence not to be forgotten, and I shall endeavor to communicate to the reader my impressions of the voyage.

We left Rochefort on the torpedo boat at seven o'clock in the morning. These boats, called Thornycrofts, after the name of their inventor, constructed by Messrs. Claparède & Company, entirely of steel plates, are very narrow and are 88 feet long. All the space is occupied, one way or another, by a steam engine of 400 horse-power, and by the two torpedo cylinders placed in front. These boats are exposed above the water only 19 inches ; their occupants are enclosed in the rear of the boat in a cabin covered with a hood of steel plates, so that no one is visible from the outside. In time of peace, however, the occupants remain outside on the plates of metal, as breathing is difficult within the cuirass. The speed of the vessel is so rapid (18 knots an hour), that the effect is extraordinary ; in the rear the rotation of the screw is so powerful that the Charente, which is very wide near Rochefort, is greatly agitated by it, producing undulations in the water which form waves of considerable height on the shores. The washerwomen and fishermen fly from the approach of the torpedo boat, which is obliged to stop, to avoid foundering their boats and wash-tubs. I was on boat No. 38 with two of my friends, and two other passengers were on board No. 51, which followed us. The torpedo boats always sail in couples, for the purpose of mutual aid in case of accident to either. On the sea, the boat in front cleaves the waves and is entirely covered with water.

The Whitehead torpedoes, employed in all these vessels, are admirable specimens of mechanism. One would call them great porpoises of steel, swimming between two waves, and traveling 600 feet to attain their destination ; the torpedo itself is a veritable ship in miniature, furnished with a propelling screw behind, and which, provided within with a compressed air apparatus. contains 60 lbs. of gun cotton. Experiments in range-finding are made entirely with dummies, as torpedoes, costing $3,000 each, cannot be uselessly sent out.

When the torpedo starts, shooting forward by means of compressed air, the spectacle is as exciting as can possibly be imagined, as it is seen and heard gliding and whistling on the surface of the water.

When the torpedo boat is at sea, and it is desired to surprise an iron-clad of the enemy, the boat is painted of the same color as the water ; there are on board different colored paints and the exterior surface of the boat can be painted in ten minutes, grey if the sky is grey, black by night and white for blue water. Under these conditions, the look-out of an iron-clad cannot detect a torpedo boat until it is within 1,500 feet. At that moment, the boat has only 900 feet to travel at full steam, it launches its torpedo at 600 feet, and can thus, by a single blow, sink a ship which has cost $4,000,000, and which carries 700 men. The torpedo boat is handled with only 5 men. But the iron-clad has, on its side, formidable torpedoes. We had the good fortune to arrive at Boyardville at the moment that the French fleet had arrived in the roadstead. The squadron comprised four large iron-clads, one of which was the Devastation, which is actually the most powerful of all the French iron-clads.

We went on board the Devastation at the time of the drill. We saw, with admiration, 12 men manage, in two minutes, guns of 58 tons, which were directed to all points on the horizon with as much ease as one would direct an opera-glass. There are four such guns on board the Devastation, beside eight others of 10 tons. First, we saw the launching of the torpedoes. The steam engines have 8,000 horse-power ; and the Devastation burns a veritable mountain of coal daily.

The torpedo school, which we visited next, after our landing at Boyardville, is organized in a very complete manner, for the study of torpedoes and all that is connected with these new appliances.

The students are numerous, very assiduous and thoroughly instructed by special instructors. On the shore there are apparatus for experiments relative to explosions by the use of dynamite, or compressed gun-cotton ; a dynamo machine actuating an electric light which projects its rays over the sea. Very ingenious systems are disposed for the explosion of submerged torpedoes, placed at the bottom of the sea for the protection of the entrances to ports.

There are to-day, in fact, three different torpedo systems adopted by the different marines. 1st, the fixed torpedo, placed at the bottom of the sea, which can be exploded by electricity carried on wires connecting with the post on shore; 2nd, the self-propelling torpedoes, of the Whitehead species, which, launched by the torpedo boats or iron-clad ships, are furnished with their own motors, and travel by themselves to strike the object intended, at 600 feet distance ; 3rd, the spar-torpedoes, which are carried to their destination by a boat manned by sailors, and which infallibly reach their intended object of attack.

One of the most distinguished admirals of our navy said to us: "The self-propelling torpedoes may be compared to the ball of a revolver, they often miss their mark; the other torpedoes, to the arm of a man at the end of a spar, it is the blade of a poignard, which strikes without fail." The buildings of the school of torpedoes are large and well ventilated They contain the construction shops, physical laboratories (especially provided with all sorts of electrical apparatus), chemical laboratories, models of the different torpedoes in common use, and the dormitories of the naval cadets. Everything is clean, and good order prevails. Everything breathes the air of discipline and the regularity of the ship ; and the visitor is received with the courteous welcome, of which the officers of the naval service so well know the secret.

GASTON TISSANDIER.

In *La Nature.*

—— In a paper, read before the Medico-Chirurgical Society, Oct. 10, 1882, and published in the *New York Medical Times* for Nov., three cases of the stricture of the urethra are given, which were cured by electrolysis, after all other methods of treatment had failed, by Dr John Butler of this city.

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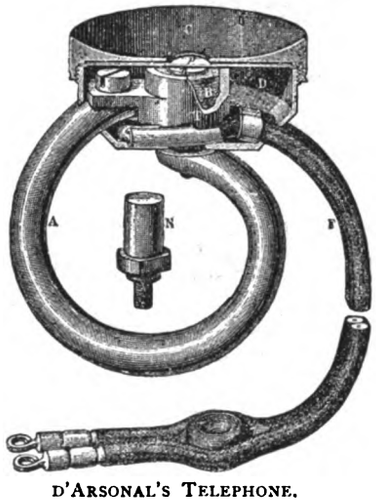
IMPROVEMENTS IN TELEPHONES.

THE *Comptes Rendus* gives some particulars of improvements in the telephone effected by d'Arsonval. His experiments proved that there existed a similiarity between the telephone and dynamo-electric machine, and that the power of the telephone was greatly increased by bringing both poles of the magnet near the vibrating plate, while considerable advantage was also obtained by having them provided with flat bobbins very close together. By this means any too strong magnetic induction is prevented, the magnets, on the contrary, being somewhat weaker when encircled with thin and flat bobbins.

The experiment, of Marcel Deprez, in constructing his galvanometer, showed that the only active part of the circuit lies between the poles of the magnet. The application of this principle to the telephone can be easily and practically proved in the following manner:

A magnet with flattened poles is brought under the vibrating plate of a telephone, and a wire, conveying an interrupted current, placed between, but in such a way, that it can be also placed outside the poles when required. It will be found that the plate will vibrate strongly when the wire is between the poles, and that the vibrations, when the wire is in any other position, will be either very weak, or altogether absent. In double poled telephones, therefore, such as Gower's, Siemen's, Ader's, the parts of the coil circuits which are not between the poles, may be considered as simply useless. D'Arsonval has therefore selected the ring shape for the magnetic field, so as to submit the whole circuit to its influence—an arrangement that has been adopted by Klés for his electro-magnets. One of the poles has a cylindrical core and carries the bobbin; the second has a ring shape and envelops the first, so that the whole bobbin is within the influence of the magnetic field. All the lines of force, of the field, are perpendicular to the wire coils, and consequently experience the maximum action of the current.



D'ARSONAL'S TELEPHONE.

The telephone is thus made in the simplest and most effective form. The magnet has the form of a spiral, which has the advantage of uniting the lines of force in a closed circuit, as was employed by Ladd, twenty years ago. The two ends of the magnet-hoop carry the cylindrical core—that is the ring—and between these ends, the bobbin is carried and enclosed, while the flat ends are brought as close as possible to the vibrating plate. The arrangement of the plate is very simple, the metal case containing it, is placed between the cylindrical core and the corresponding end of the magnet. The whole apparatus weighs only 350 grammes, but despite these small dimensions, it repeats vocal sounds with great exactness, and so clearly, that the tones can be heard throughout a room when the instrument is provided with a speaking tube.

SPARKS.

—— ON NOV. 11TH, D. J. Leamy was found dead in his lodging house, No. 48 Chatham Street. Upon forcing his door, it was discovered that he had turned on or blown out the gas.

—— ON NOV. 19TH, John McGrogan and Michael Gilroy were severely burnt about the hands, neck and face, at John and Nassau Streets, by the explosion of gas, while laying pipes for the American Steam Heating Company.

—— ON OCT. 30th, gas, which had accumulated in the Eureka Consolidated shaft, Eureka, Nev, burst with a tremendous noise. The large works were demolished, and the immense roof crushed in. The superintendent was severely injured.

—— ON THE NIGHT of Oct. 28th, in extinguishing a fire in the basement of the building, No. 791 Eighth Avenue, three men were severely burned, and four others overcome by an explosion of gas. The fire is supposed to have started from a gasoline lamp.

—— ON OCT. 28TH, Miss Sarah M. Fendick, an accomplished young lady of twenty years, was found dead in bed at No. 111 Fort Greene Place, Brooklyn. The room was full of gas, and when a physician was summoned, it was discovered that death had resulted from suffocation.

—— ON NOV. 14th, a newly married couple, Louis McCann and wife, were found suffocated by gas in the Astor Place Hotel. The *Herald* reports in connection with this case, that cases of asphyxia by gas in hotels have become so common that little official attention is paid at the Coroner's office to them.

—— ON NOV. 6th, a gas-fitter took a lighted candle to search for leaks in some unoccupied flats on West 123d Street. After finding one, he forgot to place a cap on the burner. There was an immediate explosion, which demolished the doors. Both the gas-fitter and a colored attendant were thrown to the floor; the latter was seriously injured.

—— THE *London Electrical Review*, of Nov. 4th, says: The explosion of gas which occurred at a recent committee meeting of the Mile-End Vestry, just as the question of lighting the main road, and other portions of the district, by means of electricity was being discussed, does not require much comment. It is, however, highly probable that the vestrymen, to the number of nearly a dozen, who suddenly found themselves under the table, will vote in favor of the electric light.

—— ON NOV. 10th, a dangerous fire occurred on Twenty-first Street and Avenue A. Within half a block, on First Avenue and Twentieth Street, two immense gasometers of the New York Gas Company are located, each containing 1,500,000 feet of gas. The fire was separated from one of these gasometers by only a three-story stable. The fire was extinguished with great difficulty. During its occurrence great excitement prevailed, through the close proximity of the huge gasometer, from which the gas was being slowly drawn, filling the air with its odor.

—— THE WOONSOCKET *Patriot* says: Of the many forms of electric transmitters and receivers brought out in the past few years, none show more novelty and exhibit such a marked difference in form and construction from all the others as one recently perfected by Mr. Preston C. Nason, an electrician of this place. The new instrument is only two inches in its largest dimensions, and so small otherwise that eighteen of them could be placed inside of a Blake transmitter; and, unlike the latter, the Nason has no door, lock, or hinge, no opening to speak into, no binding screws to work loose, and nothing in common with other transmitters, except the induction coil. Externally, with its hard rubber or metallic case, it resembles a small pocket match safe. After once adjusting to the line it can be removed or replaced instantly by touching a small spring at the top of the case. Although so small it will transmit words in any part of an ordinary sized room without directing the voice towards the instrument.

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—— A CONVENIENT arrangement, says *L'Electricite*, whereby a Geissler tube is rotated electro-magnetically on a supported axle above a coil standing on one end, has been devised by M. Combettes.

—— AN ELECTRICAL TRYCYLE was recently ridden through London by Prof. Ayrton. The accumulators were placed on the foot-board of the trycyle, and the motion was produced by one of Professors Ayrton and Perry's newly patented electro-motors, placed under the seat of the rider. The total dead weight of the apparatus was one and a half hundred-weight.

—— A METHOD OF signaling by means of electric balloons, was tried recently in Paris, by MM. Mangin and Baudet. The balloon, made of paper rendered translucent, was about 8 ft. in diameter, and was filied with pure hydrogen, A Swan lamp was fitted inside, and a light rope, carrying two copper wires, was attached. When the circuit was completed, the whole balloon appeared to be a globe of fire. By switching the current off and on, the Morse code can be spelled out, and thus, captive balloons of this kind can be used for signaling purposes.

—— ON AUGUST 1st, began at Göttingen, a series of magnetic observations which are to extend over the space of 14 months. They will take place under the supervision of a professor of the University of Göttingen, on the 1st and 15th of every month, at the same hours as those performed by the international expeditions sent out to the North and South Pole. Their principal object is to ascertain the magnetic condition of the earth. Some experiments will also take place with respect to magnetic intensity in the garden of the Observatory, in a pavilion built up of wood and brick only, without an atom of iron in it.

—— DR. HASE, of Hanover, has invented an electrical fire-alarm apparatus, in which a glass tube, with two terminal bulbs at its upward bent ends, partly filled with spirit of wine, is supported horizontally with a brass ring at the middle, allowing of slight rotation in a vertical plane. The system resembles a water-hammer, but one of the bulbs is blown larger than the other and has a thinner wall, so that it is very sensitive to changes of temperature. The (displaceable) brass ring is so placed that the end with the larger bulb preponderates over the other, lying on a rest. When a rise of temperature occurs, the liquid is forced into the other arm, so that the latter descends on a platinum style attached to a spring, making it dip in mercury, and so close a circuit and cause a bell to ring.

—— MR. J. J. GHEGAN, General Manager of the Mexican Northern Telephone and Telegraph Co., left New York City, for Monterey, on the 8th ult. Mr. Ghegan is one of our esteemed electrical engineers, and in this large Mexican field his ability and experience will enable him to soon build up a large business. He bade adieu to many friends who wished the new enterprise the success that has hitherto attended his labors. The principal offices of the Company are at 55 Broadway, N. Y. City. F. K. Hain, President; F. M. Delano, Vice-President; and Alvan Tenney, Secretary and Treasurer.

—— THE WASHINGTON *Post*, Nov. 10th, reports that the stockholders of the United States Electric Light Company of Washington, D. C., held a meeting yesterday for the purpose of organization, and $200,000 of the capital stock of the company was subscribed and paid for. The following named gentlemen were elected a board of directors for the ensuing year: Peter A. B. Widener, William L. Elkins and Martin Maloney, of Philadelphia; George W. Hebard, of New York, and James L. Barbour, Stilson Hutchins, Robert Boyer, Albert W. Fletcher and William Dickson, of Washington, D.C. James L. Barbour was elected the President of the Board; William Dickson, Secretary, and M. Maloney, Treasurer. Mr. N. W. Ellis, of Manchester, N. H., was appointed Superintendent. The executive committee, who will have full management in the detail of building and operating the line, are Messrs. Maloney, Fletcher and Dickson. The Washington organization of the United States Electric Lighting Company have a large number of orders for lamps already, and it is expected most of our principal stores and thoroughfares will be brilliantly illuminated before the assembling of Congress.

—— THE NEW GORDON DYNAMO is of the alternating current type, and described as the largest in existence. The total weight is about 18 tons, the revolving magnet-wheel weighing 7 tons. The machine is believed to be capable of supplying no fewer than 7,000 20-candle Swan lamps. The coils can be joined up in almost any desired manner; the E. M. F. is about 60 volts, and the resistance, when the fixed coils are connected in quantity, only ·00047 ohm.

(*For Patents, see page* 290.)

BUSINESS NOTICE.

IT will be seen by an advertisement in another column, that Prof. Curt. W. Meyer, of No. 11 Dey Street, presents for the holiday season a very perfect set of electrical instruments. In a convenient box may be found a compact electrical plate machine, perfectly capable of generating electricity, with electrical orrery, cannon, bells, ball, electrometer, Leyden jar, head of Medusa, and a Geissler, or vacuum tube, with other apparatus. Now, all these various objects are contained in a box not more than a foot square, and can be sold at the same cost as many a useless toy.

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JAMES W. ALEXANDER, Vice-Pres.
SAMUEL BORROWE, 2d Vice-Pres.
WILLIAM ALEXANDER, Secretary.
E. W. SCOTT, Supt. of Agencies.

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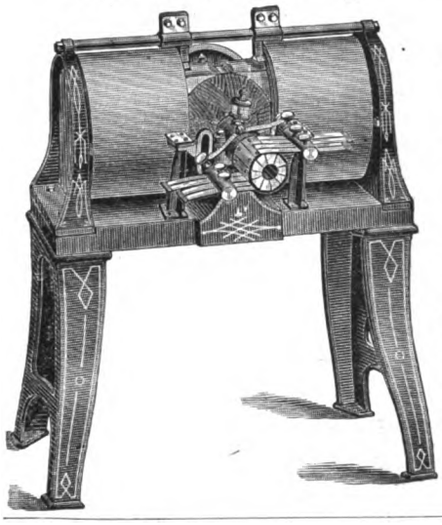

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EUGENE T. LYNCH,
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INVENTORS address JANNUS & CO., Attorneys and Counsellors in Patent Causes, Washington, D. C., for references or advice; and opinion as to patentability, **sent free.**

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To the N. Y. Agent of the College of Electrical Engineering, 122 E. 26th St., N. Y.:

"Your Dictionary of Electricity is an exceedingly good one; leaving out the old sealing wax, glass machine and amber experiments, and inserting cuts with epigrammatic descriptions of the recent great electrical inventions, makes your work very valuable; and at the low price of three dollars, the edition ought to be sold **at once.** Nearly every electrical inventor and manufacturer in U. S. and Europe, will find a cut or a description of their invention or apparatus in it."

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PATENTS FOR OCTOBER AND NOVEMBER, 1882.

October 3rd.

265,290 Electric Lighting Apparatus, Governor Valve for. G. A. Tabourin, Marseilles, France.
265,519 Electric Machine Regulator, Dynamo. J. W. Langley, Ann Arbor, Mich.
265,340 Electroplating Machines, Attachment to Dynamo. S. M. Puffer, Detroit, Mich.
265,311 Lamp and Holder for the same, Electric. T. A. Edison, Menlo Park, N.J.
265,315 Lamp, Electric. J. H. Guest, Brooklyn, N. Y.
265,475 Lamp, Electric. S. Waters, London, England.
265,410 Lamp, Electric Incandescent. J. H. Guest, Brooklyn, N. Y.
265,292 Lamp Support, Electric. W. Wheeler, Concord, Mass.
265,364 Low Water Detector, Electrical. E. H. Ashcroft, Lynn, Mass.
265,485 Magnet, Electro. T. Cochran, Brooklyn, N. Y.
265,335 Steam Boiler Cleaners, Electrical Alarm for. E. H. Ashcroft, Lynn, Mass.
265,297 Telegraph, Automatic. F. Anderson, Peekskill, N. Y.
265,358 Telegraph, Automatic. F. Anderson, Peekskill, N. Y.
265,352 Telegraph, Printing. A. Wirsching, Brooklyn, N. Y.
265,488 Telegraphy, Dynamo. G. D'Infreville, New York, N. Y.
265,489 Telegraphy, Dynamo. G. D'Infreville, New York, N. Y.
265,456 Telephone Calls, Combined Key-Board, Automatic Switch and Magneto-Generator for. J. P. Stabler, Sandy Spring, Md.
265,455 Telephone Calls, Signal Transmitter for. J. P. Stabler, Sandy Spring, Md.
265,454 Telephone Local Call Instrument. J. P. Stabler, Sandy Spring, Md.
265,412 Telephone, Mechanical. W. E. Hathaway, and W. B. Johnston, Hornellsville, N. Y.

October 10th.

265,775 Electric-arc Light. T. A. Edison, Menlo Park, N. J.
265,936 Electric Conductors, Preventing Flashing Between. E. Thompson, New Britain, Conn.
265,776 Electric Lighting System. T. A. Edison, Menlo Park, N. J.
265,785 Electric Machine, Dynamo. T. A. Edison, Menlo Park, N. J.
265,858 Electric Machine, Dynamo. H. J. Müller, New York, N. Y.
265,779 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
265,780 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
265,781 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
265,782 Electric Machine Regulator, Dynamo. T. A Edison, Menlo Park, N. J.
265,783 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
266,784 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
265,858 Electric Machine Regulator, Dynamo. J. F. Ott, Newark, N. J.
265,859 Electric Machine Regulator, Dynamo. J. F. Ott, Newark, N. J.
265,937 Electric Machine Regulator, Dynamo. E. Thomson, New Britain, Conn.
265,677 Electric Signal. I. Kitsee, Cincinnati, Ohio.
265,753 Electric Signaling Apparatus. J. H. Cary, Boston, Mass.
265,786 Electrical Transmission of Power, Apparatus for the. T. A. Edison, Menlo Park, N. J.
265,576 Electrical Transmitter. G. J. Carney and J. V. Meigs, Lowell, Mass.
265,861 Electrode for Batteries. I. Pitkin, Clerkenwell, County of Middlesex, England.
265,594 Insulating Electrical Wires. G. A. Gage, Chicago, Ill.
265,737 Lamp, Electric. G. W. Beardslee, Brooklyn, N. Y.
265,790 Lamp, Electric. M. G. Farmer, Newport, R. I.
265,810 Lamp, Electric. D. N. Hurlbut, Chicago, Ill.
265,670 Lamp, Electric-arc. J. H. Guest, Brooklyn, N. Y.
265,777 Lamps, Treating Carbons for Electric. T. A. Edison, Menlo Park, N. J.
265,778 Railway Engine, Electro-magnetic. T. A. Edison, Menlo Park, N. J.
265,736 Railway Trains, Electric Signal for. J. P. Clark, Philadelphia, Pa.
265,757 Railway Trains, Electric Signal for. J. P. Clark, Philadelphia, Pa.
265,645 Telegraph, Multiplex. B. Thompson, Buffalo, N. Y.
265,720 Telegraphic Cables, Grapnel for Raising. S. Trott, and H. Kingsford, Halifax, Nova Scotia, Canada.
265,789 Telegraphic Recording Instrument. S. V. Essick, Alliance, Ohio.
265,897 Telephone Switch. T. A. Watson, Everett, Mass.
265,621 Underground Conduits, Wire Support for. A. H. Mershon, Philadelphia, Pa.
265,774 Weber Meters, Maintaining Temperature in. T. A. Edison, Menlo Park, N. J.
265,912 Watchman's Electric Register. G. W. Adams, Boston, Mass.

October 17th.

266,252 Burglar Alarm. M. Decker, and J. K. Deming, Chicago, Ill.
265,993 Electric-arc Light. E. Thomson, New Britain, Conn.
266,241 Electric Circuits, Cut-out for. E. Weston, Newark, N. J.
266,171 Electric Conductors, Conduit for Underground. W. Mackintosh, Providence, R. I.
266,243 Electric Machine, Dynamo or Magneto. E. Weston, Newark, N. J.
266,244 Electrical Indicator. E. Weston, Newark, N. J.
266,289 Electrical Transmission of Power, System for the. E. Weston, Newark, N. J.
266,107 Elevators, Electric Safety Device for. R. M. Curtiss, Brooklyn, N. Y.
266,129 Galvanic Battery, Portable. C. Gibbs, New York, N. Y.
266,242 Lamp, Electric. E. Weston, Newark, N. J.
266,161 Lamp, Electric arc. O. Kartzmark, New York, N. Y.
266,240 Lamp, Electric-arc. E. Weston, Newark, N. J.
266,236 Lamps, Carbon Holder, for Arc. A. G. Waterhouse, New York, N. Y.
266,234 Lamps, Device for Suspending Arc. A. G. Waterhouse, New York, N. Y.
266,167 Lamps, Manufacture of Incandescent Electric. J. V. Nichols, Brooklyn, N. Y.
266,075 Lightning Rod, Joint or Coupling. C. E. Ball, Philadelphia, Pa.,
266,235 Magneto or Dynamo Electric Machine. A. G. Waterhouse, New York, N.Y.
266,027 Railway Signal, Magneto-electric. W. W. Gary, Boston, Mass.
266,172 Secondary Batteries, Plate for. J. A. Maloney, Washington, D. C., C. H Koyl, Cobourgh, Ont., Canada.
266,090 Secondary Battery. C. F. Brush, Cleveland, Ohio.
266,114 Secondary Battery. A. K. Eaton, Brooklyn, N. Y.
266,262 Secondary Battery. W. A. Shaw, Brooklyn, N. Y.
266,089 Secondary or Storage Battery Element. C. F. Brush, Cleveland, Ohio.
266,176 Telegraph, Printing. W. J. McCausland, Philadelphia, Pa.
266,021 Telephone. T. A. Edison, Menlo Park, N. J.
266,022 Telephone. T. A. Edison, Menlo Park, N. J.
265,972 Telephone Circuit and Apparatus. W. D. McKinney, Boston, Mass.
266,056 Telephone Exchange, Mechanical. G. F. Shaver, Erie, Pa.
266,043 Telephonic Transmitter. G. F. Milliken, Boston, Mass.

October 24th.

266,405 Annunciator, Electric. J. C. Warner, Chicago, Ill.
266,319 Annunciators of Telephone Exchanges, Circuit for. C. E. Scribner, Chicago, Ill.
266,353 Electric Cable. P. B. Delany, New York, N. Y.
266,290 Electric Generator, Dynamo. R. C. Hindley, and W. S. Buffham, Racine, Wis.
266,483 Electrical Distribution, Junction for Conductors of Systems of. J. Kruesi, Menlo Park, N. J.
266,549 Electrical Fixture. L. Stieringer, New York, N. Y.
266,467 Electrical Machine. E. Guerin, Paris, France.
266,363 Lamp, Electric. C. F. Heinrichs, London, England.
266,337 Lamp, Electric-arc. J. D. F. Andrews, Charlton, County of Kent, Eng.
266,455 Lamp, Electric arc. W. P. Freeman, New York, N. Y.
266,447 Lamp, Electric Incandescent. T. A. Edison, Menlo Park, N. J.
265,358 Lamp, Electric Incandescent. H. Goebel, New York, N. Y.
266,303 Lamp Globes, Apparatus for Creating Vacuums in Incandescent-electric. H. J. Mullen, New York, N. Y.
266,592 Telegraphs, Perforator for Automatic Printing. A. F. and F. B. Johnson, Brooklyn, N. Y.
266,593 Telegraphs Perforator for Automatic Printing. A. F. and F. B. Johnson, Brooklyn, N. Y.
266,292 Telephone, Battery. L. Jacobson.
266,344 Telephone, Central Office System and Apparatus. H. W. Breckenridge, and J. W. Duxbury, Providence, R. I.
266,321 Telephone Exchange System. C. E. Scribner.
266,287 Telephone Exchanges, Multiple Switch Board for. C. C. Haskins, and C. H. Wilson, Chicago, Ill.
266,567 Telephone, Magneto. T. A. Watson.
266,295 Telephone Switch. C. W. Lewis.
266,374 Telephone Switch. C. W. Lewis.
266,320 Telephone Switch Board and Pneumatic Signal therefor. C. E. Scribner,
266,277 Telephonic Receiver and Automatic Circuit Breaker Combined. W. C. Eckert, J. A. Seeley, E. A. Eckert, Cincinnati, Ohio.

October 31st.

266,703 Carbon Conductors, Apparatus for Heating. T. E. Lockwood, Paris, France.
266,854 Electric Circuits, Implement for Closing and Testing. L. Mann, Detroit, Mich.
266,793 Electric Distribution System. T. A. Edison, Menlo Park, N. J.
266,677 Electric Lines, Conduit for. R. H. Corbett, New York, N. Y.
266,855 Electric Machines, Commutator Brush for Dynamo. W. B. Mason, Boston, Mass.
266,681 Electrical Conductors, Conduit for. G. S. Eaton, Brooklyn, N. Y.
266,916 Electrical Conduit, Underground. S. D. Strohon, Philadelphia, Pa.
266,762 Electrodes for Secondary Batteries, Making. C. F. Brush, Cleveland, Ohio.
266,798 Galvanic Batteries, Containing Vessel for. C. A. Faure, Paris, France.
266,957 Interlocking Apparatus, Hydraulic and Electric. O. Gassett, Boston, Mass.
266,741 Lamp, Incandescent Electric. E. Weston, Newark, N. J.
266,739 Lamps, Shunting Device for Electric. E. Weston, Newark, N. J.
266,740 Magneto or Dynamo-electric Machine. E. Weston, Newark, N. J.
266,904 Railway Signaling Apparatus, Electric. C. A. Scott, Boston, Mass.
266,806 Railway Train Electric Signaling Apparatus. E. T. Gilliland, Indianapolis Ind.

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263,750 Telephone Switch. S. Bergmann, New York, N. Y.
266,615 Telephone Transmitter. D. Draubaugh, Eberly's Mill, Pa.
266,853 Telephones, Connecting Device for Operators. L. Mann, Detroit, Mich.
266,746 Telephonic Receiver. S. E. Beedy, Farmington, Me.
266,747 Telephonic Transmitter. S. E. Beedy, Farmington, Me.
266,953 Carbon Black, Apparatus for Manufacturing. J. T. Dysart.

November 7th.

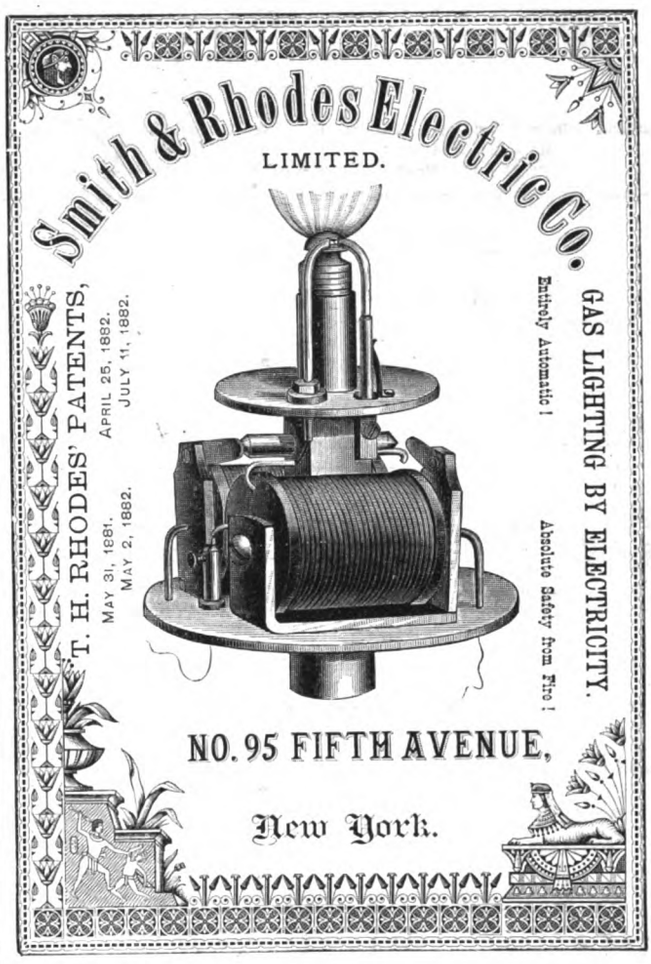
266,969 Chandelier for Electric Candles. C. A. Cheever, New York, N. Y., and W. L. Candee, Brooklyn, N. Y.
267,299 Clock for Making Electric Signals. R. W. Willson, New Haven, Conn.
267,287 Circuit closer. L. Waldo, New Haven, Conn.
267,300 Clocks, Device for Synchronizing. R. W. Wilson, New Haven, Conn.
267,062 Distance Register, Electric. E. R. E. Cowell, Detroit, Mich.
267,136 Electric Machine, Dynamo. V. W. Blanchard, New York, N. Y.
267,196 Electric Machine, Dynamo. E. J. Harling, and E. Hartmann, London, England.
266,993 Electric Machine, Dynamo. P. Jablochkoff, Paris, France.
267,263 Electric Machine, Dynamo. G. A. Scheefer, Evansville, Ind.
267,278 Electrical Currents, Metallic Circuit for. S. D. Strohm, Philadelphia, Pa.
267,279 Electrical Currents, Metallic Circuit for. S. D. Strohm, Philadelphia, Pa.
267,259 Electro-pneumatic Gate and Signal Operating Apparatus. W. Robinson, Boston, Mass.
267,025 Electro-therapeutic Apparatus. J. W. See, Hamilton, Ohio.
267,046 Insulating Compound for Electric Wires. R. S. Waring, Pittsburg, Pa.
267,045 Insulating Material for Electric Uses. R. S. Waring, Pittsburg, Pa., and J. B. Hyde, New York, N. Y.
267,044 Insulating Wires for Electric Uses, Process of and Apparatus for. R. S. Waring, Pittsburg, Pa., and J. B. Hyde, New York, N. Y.
267,155 Lamp, Electric-arc. C. A. Cooley, New Britain, Conn.
267 138 Magnet, Electro. V. W. Blanchard, New York, N. Y.
267,137 Secondary Battery. V. W. Blanchard, New York, N. Y.
267,275 Secondary Battery. E. T. Starr, Philadelphia, Pa.
10,232 Telegraph, Railway Car, (Re-issue). J. R. Finney, Pittsburg, Pa.
266,987 Telegraph, Ship. J. S. Gisborne, Charing Cross, County of Middlesex, England.
267,144 Telegraph Switch. R. Brougham, Hedden St., Regent St., County of Middlesex, England.
267,203 Telephone, Mechanical. H. E. Huston, Monticello, Ill.
267,058 Telephone Systems, Electric Circuit for. J. W. Brennan, Chicago, Ill.
267,059 Telephone Systems, Electric Switch and Circuit for. J. W. Brennan, Chicago, Ill.
267,115 Tower for Electric Lights, &c. C. D. F. Smith, Aurora, Ill.

November 14th.

267,597 Electric Cables, Machine for the Manufacture of. W. H. Sawyer, Providence, R. I.
267,446 Electric Machines, Electric Governor for Driving Engines for Dynamo. S. D. Mott, Menlo Park, N. J.
267,353 Electrotypes, Machine for Notching and Trimming. C. M. Letz, Chicago, Ill.
267,319 Galvanic Battery. A. Bernstein, Berlin, Germany.
267,577 Galvanic Battery. G. W. O'Harra, Kalamazoo, Mich.
267,553 Lamp, Electric-arc. N. McCarty, Brooklyn, N. Y.
267,474 Lamp, Electric-arc. E. Weston, Newark, N. J.
267,647 Lamp, Incandescent Electric. S. H. Emmens, London, England.
267,445 Measuring Electric Currents. S. D. Mott, Menlo Park, N. J.
267,437 Station Indicator, Electric. J. F. Loughlin, Hyde Park, Mass.
267,609 Telegraph Cable. C. J. Slafter, Grand Junction, Mich.
267,366 Telegraph Printing. G. M. Phelps, Brooklyn, N. Y.
267,387 Telephone System. T. A. Watson, Everett, Mass.
267,409 Underground Lines, Conduit for. W. B. Eltonhead, Philadelphia, Pa.
267,458 Gas Engines, Electrical Igniting Device for. A. K. Rider, Walden, N. Y.

BUSINESS ADDRESSES.

Ahlstrom, O. G. Manufacturer of Electrical Instruments, Batteries and Supplies, 162 William St., New York.
Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.
Burnap, W. H. Davis & Kidder's Electric Machines, 259 West 27th Street, New York.
Dow, George Q. Telegraph and Telephone Poles; Pins and Brackets, pointed and plain, North Epping, N. H.
Edson's Speed & Pressure Recording & Alarm Gauges, for "Steam Dynamo-machines," indispensable for safety & economy, office 91 Liberty St., N.Y.
Galvano Faradic M'f'g Co., Electrical Instruments for Medical Use, 335 Fourth Ave., New York.
Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.
Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.
Wenzel, A. C. Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 114 Centre Street, New York.



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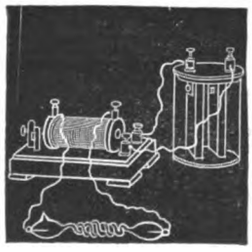

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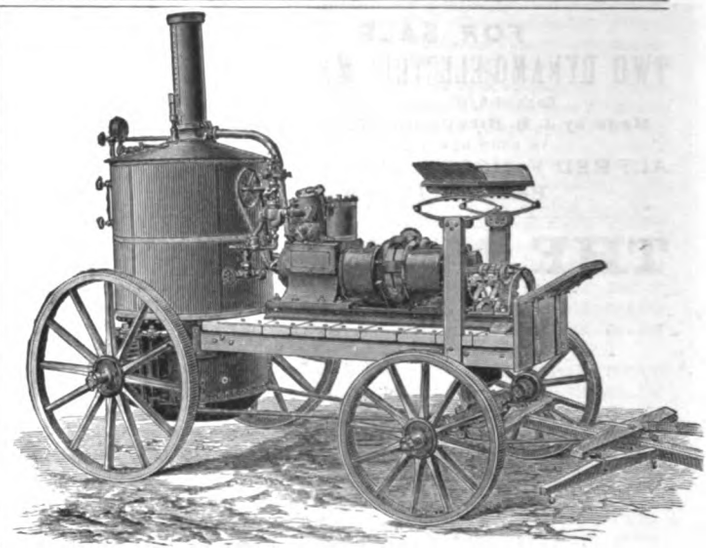

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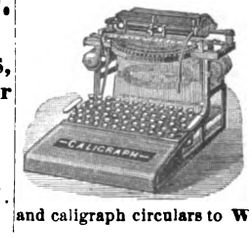

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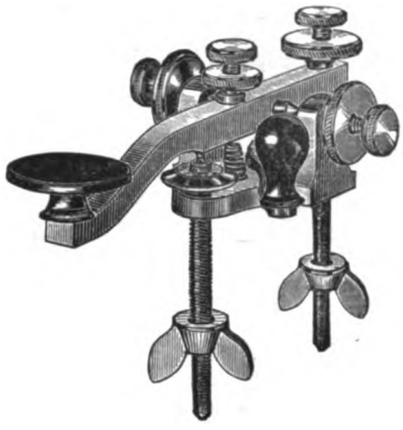

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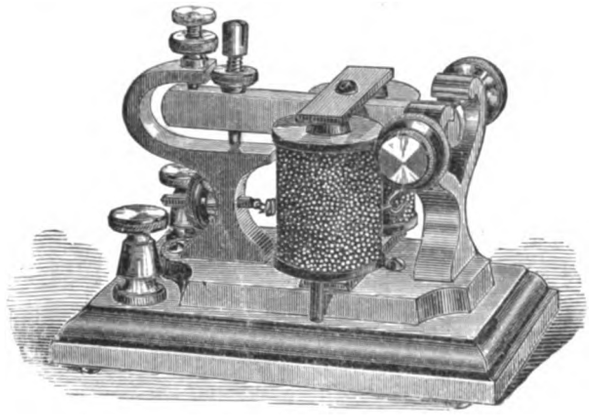

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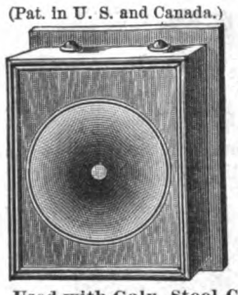

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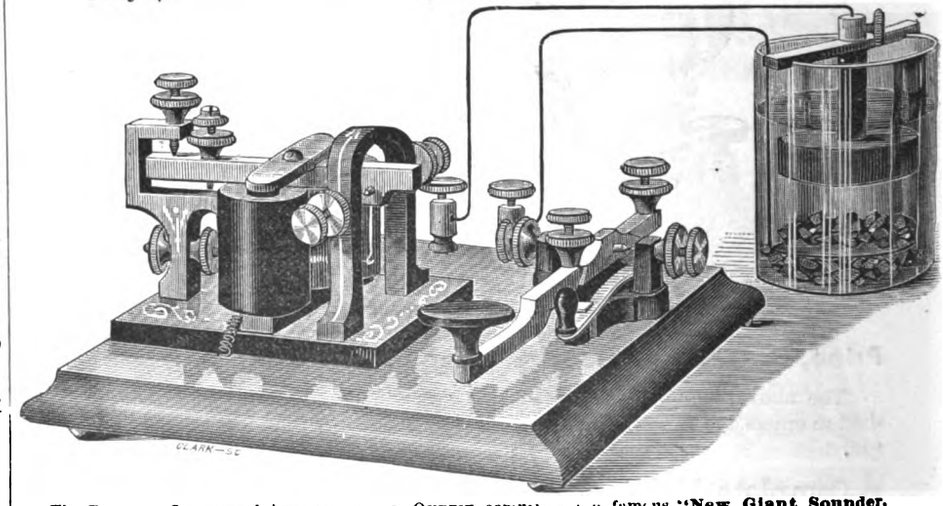

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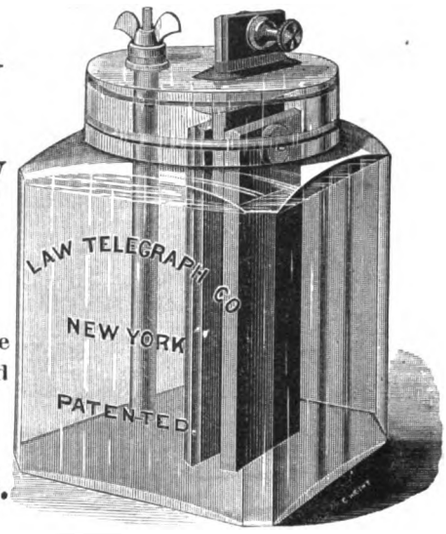

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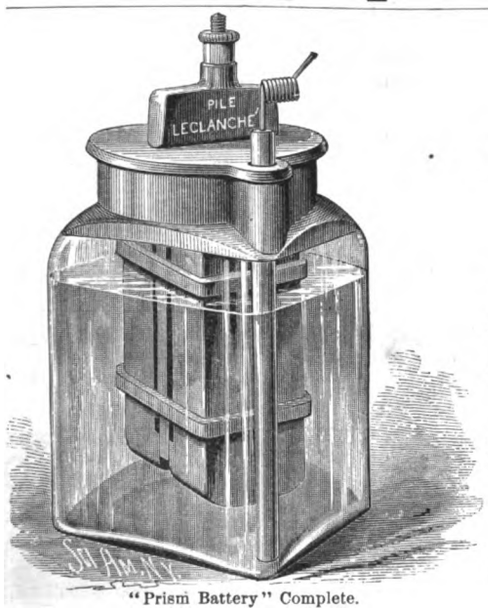

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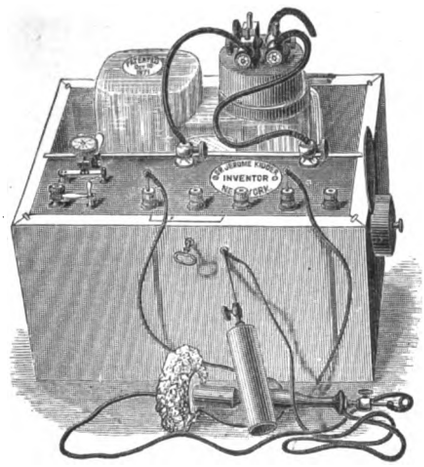

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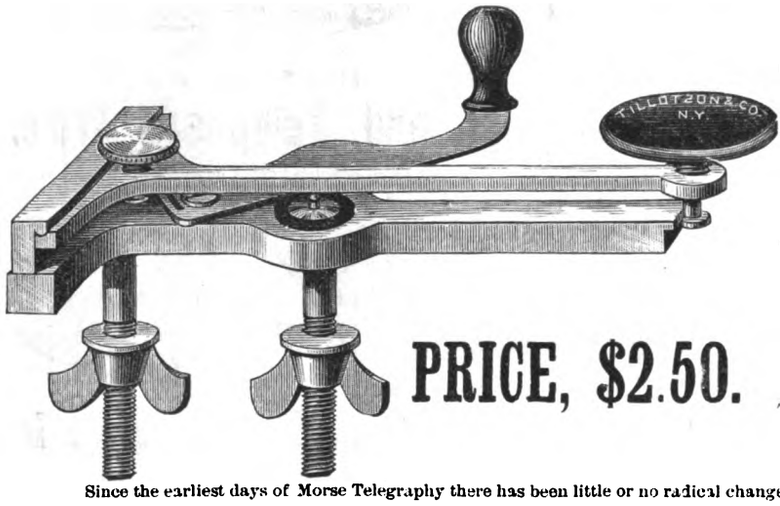

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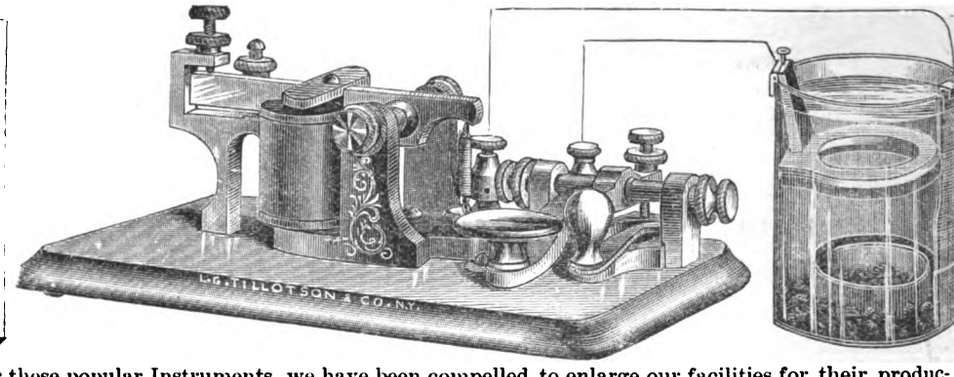

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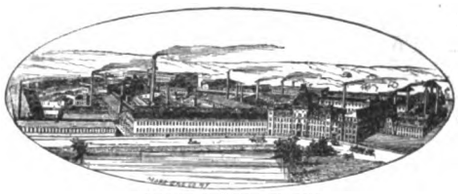

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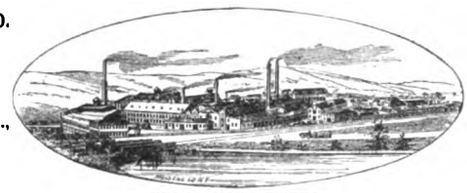

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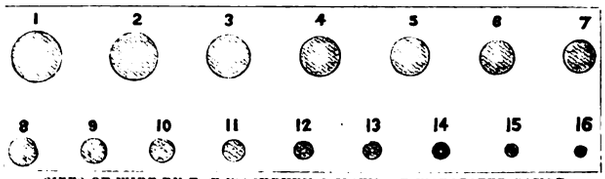

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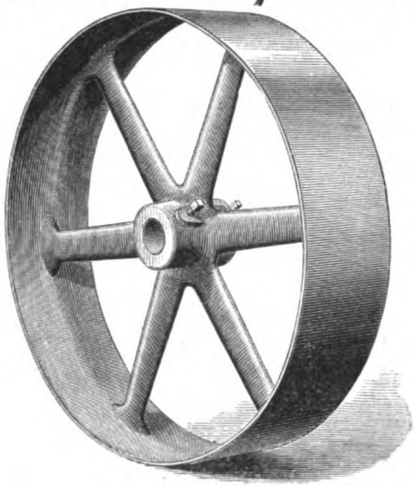

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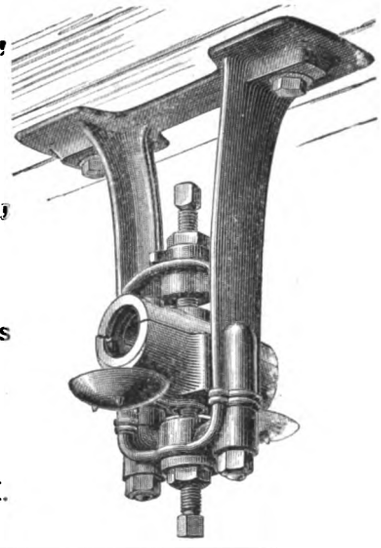

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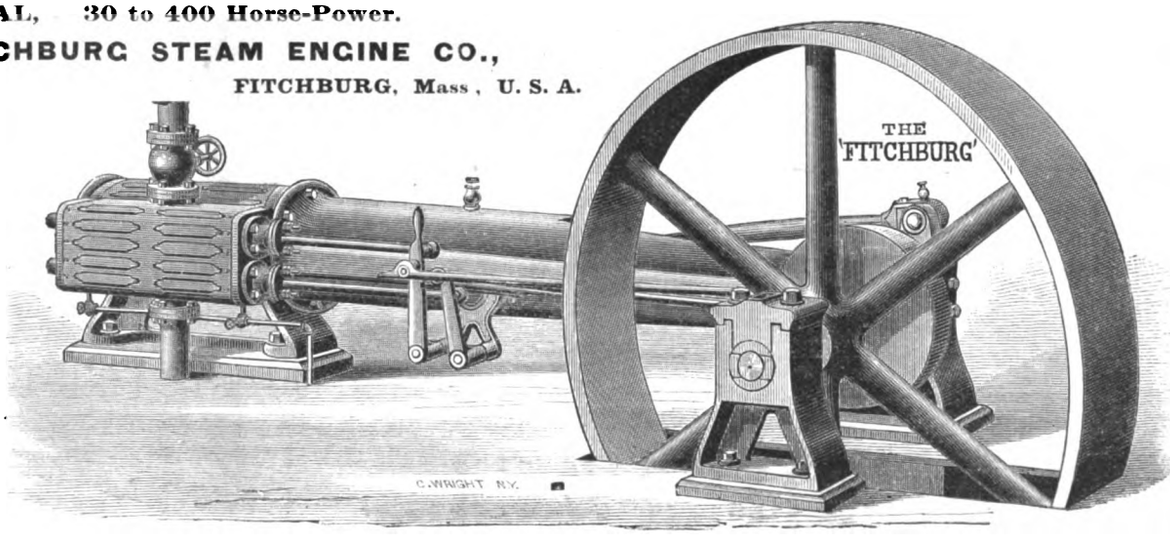

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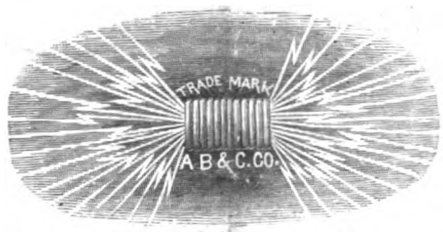

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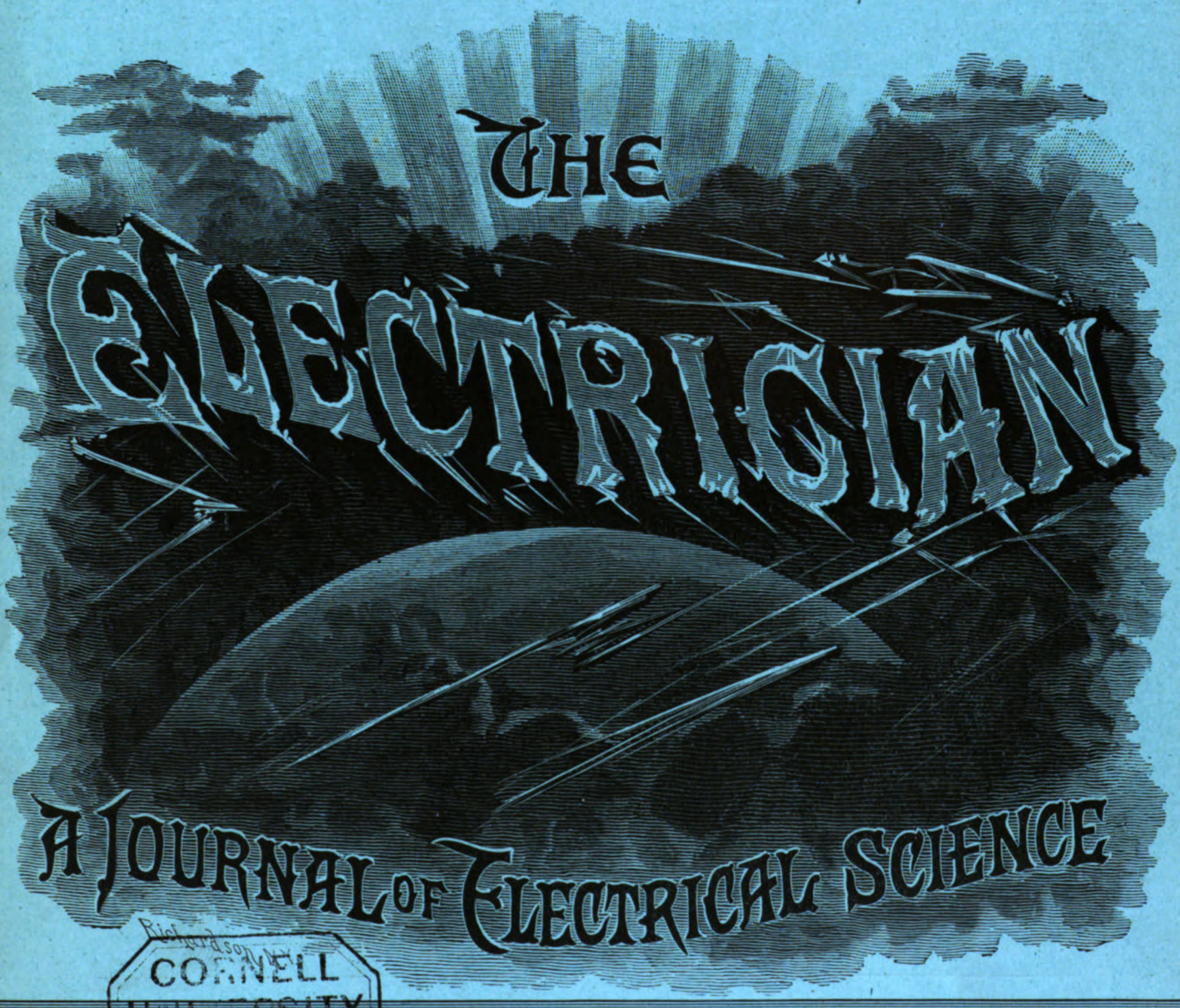

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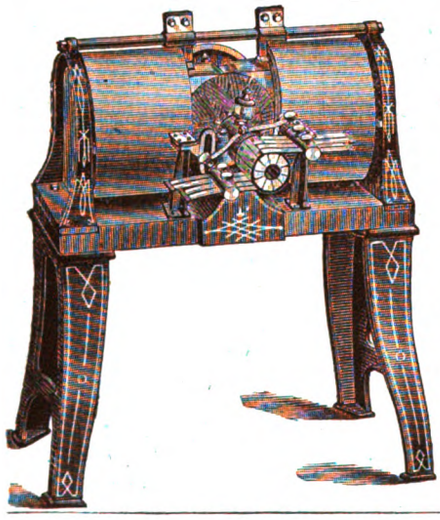

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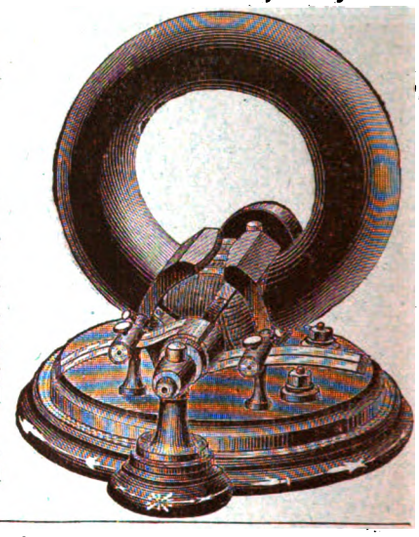

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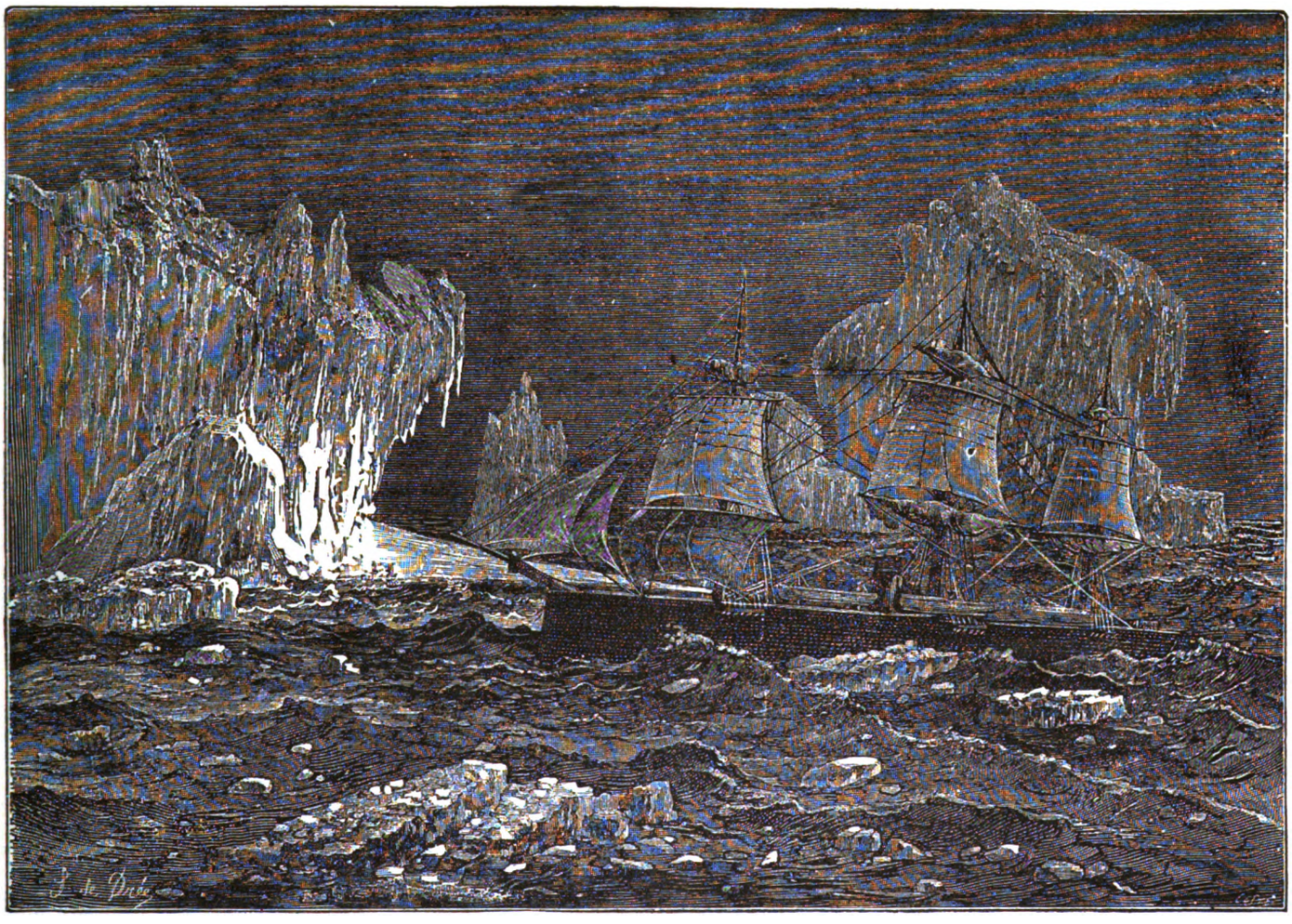
THE ELECTRICIAN.

Vol. II. No. 1.] JANUARY, 1883. [$1.00 a Year. 10 Cents a Copy.

ELECTRICITY AT SEA.

WITH the increase in the number of steamers and sailing vessels, the danger from collision has enormously increased, the more so that the majority of steamer lines, etc., choose the same ocean "lane." The danger is rendered far greater by the notoriously defective illuminating apparatus; many accidents being caused by the very confusion of lights—green, blue, red, etc.—that give but an imperfect idea even of the position of, and the direction in which a vessel may be moving. The lights are seen, but as lights without any illuminating power. The adoption of the electric light would certainly prove of the greatest benefit. Steamers having the electric lamp would not only have an illuminated lane before them, but would form ocean lighthouses to other vessels, thus preventing the very possibility of collision. It may well be asked why this safeguard has not been adopted; why its use has not been made imperative? The accident to the "Alaska" seems to have given the owners the idea of having the Guion steamers provided with the electric light; oil and candles being totally tabooed

The French steamers were pioneers in this commendable introduction of electricity; and, owing to recent improvements in lamps—especially by Serrin—the luminous rays can be perfectly controlled. The engraving shows in a striking manner, the danger on the one side, and the remedy on the other. The huge ice mountains remain as ever in the frozen North, and are ready as ever to crush the puny might of man, unless the inventions that make him almost superior to nature are made available.



ELECTRICITY AT SEA.

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NEW TELEPHONIC APPARATUS.

EVERY day we see new forms of telephones, which are naturally regarded, by their authors, as superior to all that have preceded them.

It is so difficult to appreciate the slight differences which distinguish between the effects of one telephone and those of another, that comparisons are very uncertain, and when superiority is claimed, care must be taken, before admitting it, to fully understand in what it consists. By some it is recognized in the greater intensity of sounds produced, by others in the perfect clearness, natural quality or "timbre" of the reproduced voice, simplicity of construction, ease of installation, or low cost. When well regulated, the differences presented by these different apparatuses, are, perhaps less important than is generally believed, and I think that the perfection claimed for them is often due simply to accuracy of construction. However this may be, it is interesting to follow the reasoning, more or less specious, upon which a claim of improvement is founded, and it is always with pleasure that we describe an apparatus based upon a new idea.

TELEPHONE OF MR. GOLOUBITZKY.

Among the apparatus of this kind, that this journal has not already described, may be presented that of Mr. Goloubitzky, which, admirably constructed by Mr. Leuczewsky, has afforded important results.

Starting from the fact that several telephones, placed at a receiving station, can without sensible loss of sound in any of them, simultaneously reproduce the speaker's voice, Mr. Goloubitzky conceived that by condensing all of them in one, an instrument might be contrived which would produce more powerful sounds.

The idea led him to think that several magnets, simultaneously acting upon the same diaphragm, might solve the problem, but it would be necessary that the vibrations produced by them should be concordant, and not give origin to interferences of the sonorous waves. It seemed to him that the individual action of each of these several magnets, acting in unison upon a single membrane, must aid the others to augment the vibration, and that, in a proportion as much greater, as its influence is exerted upon a larger surface, and moreover,upon a membrane already set in motion by similar neighboring influences.

Recollecting that if in the mechanism of a clock the isochronism of its movements be regulated by one of the branches of a diapason, and that if, even a powerful exterior cause, intervene to destroy this isochronism, the vibration of the other branch, which is free, suffices to maintain it. The synchronism of the autographic telegraph of Mr. d'Arlincourt, which is so perfect, is based upon this principle. Therefore, in admitting that the resistance of the diaphragm in some one of its parts, might possibly restrict the amplitude of the vibration determined by one of the magnets, a second, a third, or even a fourth magnet vibrating it in the same manner, should tend to amplify the normal vibration, and this action must be as much more effectual as it is exerted upon a body already put in motion.

Since the presence of several magnets before a diaphragm must divert their polar action from the centre, and since to obtain the maximum of effect it is necessary to have both poles of each magnet act at once, Mr. Goloubitzky inquired what should be the position of these magnets around the central point of the diaphragm, which would be the most favorable to the development of its vibration, and he was thereby led to study the manner in which a telephonic diaphragm vibrates under the influence of sonorous waves resulting from articulate sounds. It appeared certain that to arrange the best conditions he should locate his magnetic poles with reference to the lines of the diaphragm corresponding to its ventral segments, points, whereupon the electro-magnetic action could be the most effectually exerted, since they would correspond to the parts susceptible of being put in motion by influences which would determine the proper vibration of the plate.

His experiments were made, in the beginning, with the box of a large Gower telephone, which was about 17 centimetres (an American five-cent piece is two centimetres), in diameter, and in the base of which was stretched a double membrane of parchment.

Projecting in the acoustic tube, a sonorous wave, the first membrane would be vibrated and transmit its vibrations to the second by the intermediation of the film of air between the two membranes. Now, when upon the second membrane some powdered lycopodium was dusted it was expected to indicate, by its distribution upon the surface, the nodal and ventral areas of the first or acting membrane corresponding to any special sound. It is unnecessary to add that the experiments were extraordinarily delicate.

By speaking in the acoustic tube the different letters of the alphabet, Mr. Goloubitzky obtained a series of figures which he has related to a diameter of membrane divided in 17 equal corresponding parts of 1 centimetre each, (half the diameter of a five-cent piece) in order that they may be easily described.

"For the letter *e*, says he, the centre of the membrane constitutes a *node* where no vibration occurs, and around this centre extends an annular region, two divisions and a half (or two and a half centimetres) in width. This again is circumscribed by an annular space of from 2½ to 3 divisions in width, corresponding to a new node, which again is encircled by a new zone of vibration extending to the border of the membrane, and from 2½ to 3 divisions in width.

"From these figures it results, that at a distance of about 2½ centimetres from the centre of the membrane—that is to say, about in its median region, occurs an almost inert annular space, which, however, is not homogeneous in all its parts, for the lycopodium forms within it certain circular and elliptic accumulations, exceedingly complicated, which indicate points of minimum vibration; disposed undoubtedly in a definite order, but which, from default of photographic reproductions, I have not had the leisure to study from a scientific point of view. I am able, however, to conclude from these experiments, incomplete as they undoubtedly are, that a circular vibrating plate has a node at its centre, and that the region adjoining this centre, where the vibrations are most easily manifested, is an annular ring about 2½ centimetres (1 inch) wide.

"For the letter *e*, spoken in the tube, the little heaps of lycopodium powder in the space corresponding to the annular node, formed two large ellipses in one direction, and two small circles in the perpendicular direction. The central circle was distinguished by a dozen little heaps of the powder, arranged symmetrically around it. For the letter *o*, the figure was very nearly the same as for the letter *e*, at least as respects the central part, but the annular node presented its elipsoidal figure more greatly extended, and the little circular figures disappeared, when the sound was loud and strong, and so completely that the ring then plainly resembled a printed letter *O*.

"The figure corresponding to the combination of letters *ou*, showed around the central spot a series of little circular spots, as with the letter *e;* but they were disposed in groups of five at the opposite extremities of the same diameter, being in groups of two only upon each side, on the line of the perpendicular diameter. The sound of the letter *i*, gave rise to a great many little circular spots in the central part, which were surrounded by a more compact part, around

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which, again, many little circular spots were developed. For the word 'allons' (go on), the vibration was very feeble, and extended only to a distance of two centimetres (about ¾ of an inch) from the centre of the plate. It was hardly visible near the circumference. For the word 'attendez' (wait), the figure somewhat resembled that of the letter *a*. I have, further, more than once noticed, that for loud sounds, the little circular spots became elongated and flattened, which indicated that the nodes augmented in size, while for low tones, on the contrary, they became more convex and reduced in diameter.

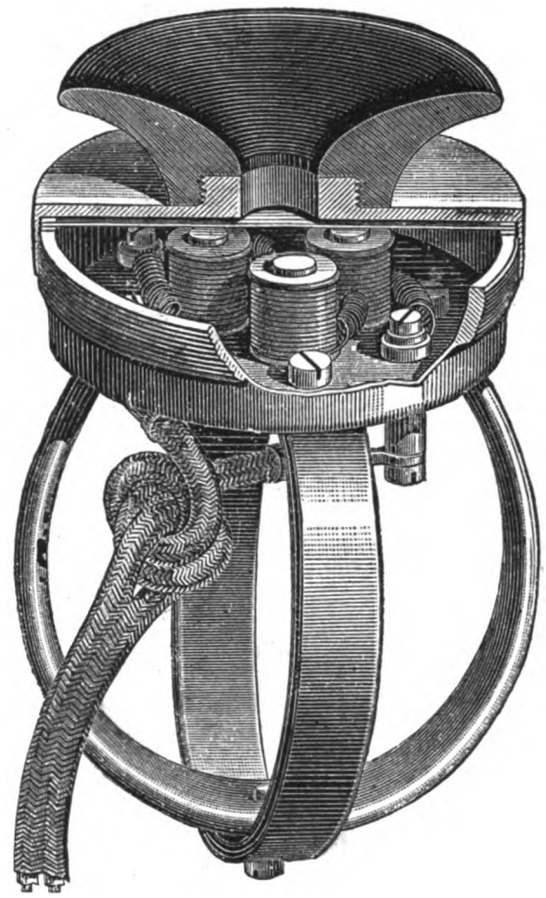
"The difficulty of reproducing these figures without the aid of photography, has hindered me from continuing the study; but my experiments have sufficed me to decide upon that which I wished to know, relating to the best disposition for a telephonic combination, and convinced me that the inert part of the centre of a telephonic diaphragm can, sometimes, attain more than one centimetre (2-5 of an inch) in diameter, while the part where the vibrations are propagated occupies the median portion of the plate, at about one-third of its diameter. Now, this demonstrated to me that I could, advantageously, remove my magnets from the centre of the diaphragm."

In accordance with his preceding considerations, Mr. Goloubitzky arranged before the two telephonic diaphragms, and within the annular region, corresponding to their vibrating segments, the poles of several iron horseshoe magnets, crossing each other, and disposed with relation to each other in different ways; sometimes he made use of four, the poles of which were ranged around the centre of the diaphragm, in the form of a square; sometimes he employed only two, crossed at a right angle, as shown in the annexed figure, in which case the poles form the four angles of a perfect square. This arrangement seemed to be the most economical, and is adopted. The relative disposition of the similar or opposite poles, has also been studied by Mr. Goloubitzky, and that in which a south pole is situated between two north poles, and a north pole between two south poles, appeared to him to give the best results; but to realize these results it was found necessary to charge the magnets before mounting them, as they could be better adjusted with relation to the diaphragm if previously magnetized.

The latter method of construction, in which the two poles, north and south, are arranged, one by the side of the other, presents some advantages, for it permits a more easy magnetizing, since it is then only necessary to rest them, two by two, upon each of the poles, of an active electro-magnet, and to prolong the contact about five minutes; no part need be dismounted or readjusted, and the regulation of the diaphragm is easily effected, for it may be separated from the cylindrical box of the telephone by a narrow rim of copper placed upon its edges, and by more or less unscrewing the cover carrying the telephone mouth-piece; the diaphragm may be given sufficient of play to allow of its suitable separation from the four magnetic poles.

Its adjustment may be regulated by the sound that is heard by tapping on the diaphragm crossing the opening of the embouchure. The bobbins of the electro-magnet were connected in the beginning in such a manner as to correspond to the other two different poles of a single magnet, and the two pair of bobbins were associated in such a manner that the current passed from one through the other in tension.

Mr. Goloubitzky made experiments to assure himself of the power of his apparatus, which, according to his judgment, is superior to that of the best telephone known to date, in the proportion of 120 to 40. We allow him the sole responsibility for this assertion, contenting ourselves with reporting the manner in which he made his comparative experiments. He employed, as transmitter, a microphone of the Gower bell system, upon the plate of which he applied a metallic wire, fixed to the superior part of a metronome. The circuit of the transmitter ended at a commutator, which could put the microphone in circuit successively with several telephones of different kinds furnished with acoustic funnels. Afterwards he successively removed the ear from these trumpets, until the sounds of the metronome, reproduced by them, were no longer perceptible. Now in making the experiment he found that for some it was necessary to remove the ear 20 centimetres, for others 40 centimetres, and for his own 120 centimetres. Having not verified the assertion, I have no more to say regarding the experiment, than, that any one can repeat it at pleasure.



As we see, the apparatus of Mr. Goloubitzky is based upon good reasoning, and this alone recommends it to our attention. We may, however, in time make some experiments with it, which will enable us to form ideas of our own respecting its practical value, and in the meantime we present it as an object of great interest.

TH. DU MONCEL,
In *La Lumière Électrique.*

—— THE *Yonkers Gazette* of Dec. 2d., says, that the Yonkers Fuel Gas Company is now putting in an electric lighting station with a capacity of three hundred thousand candle power, which is considered adequate to supply the present demands of Yonkers, Mt. St. Vincent, and Riverdale. The wonderful state of perfection to which this company has brought its system of lighting must insure for it general adoption. Already several of the large establishments on the line of the New York Central and Hudson River Railroad are arranging to put it in; and within a few weeks we may expect to see a continuous blaze of electric light from Mt. St Vincent to Glenwood. We understand that the motive power used by the company is gas engines run by fuel gas, at a cost of 3 cents for gas, per hour, for each lamp, and that the system referred to is the U. S. Electric Lighting Co's.

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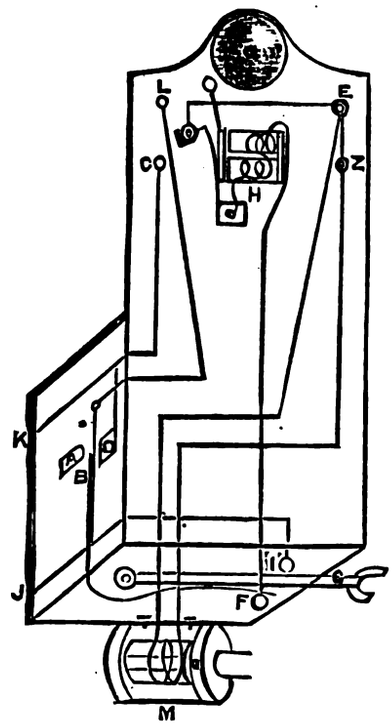
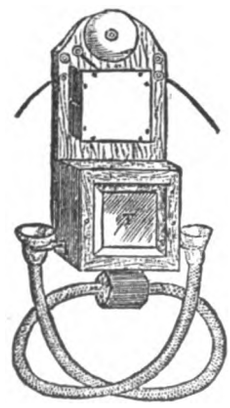
THE SIMPLEX TELEPHONE.

A CORRESPONDENT, of a foreign cotemporary, sends a sketch of switching for the Simplex Telephone—the front, top, and one side removed to show the connections. It is manipulated as follows :—To call the distant station, press the button *A*, which breaks contact at *B*, and puts the line, *L*, and carbon of battery, *C*, in contact at *D*. The circuit is completed by putting the zinc of battery to *Z*, whence the current passes through the receiver *M*, and out at *E*—either to earth or return wire. By this arrangement the ringing at the distant station is repeated, or made known at the sending station. The contacts at *B*, are made with two strips of hard rolled metal, and continued under the lever *G*, which must be kept down on *F*, while signaling with the bells, but be in contact with *I* when speaking. This is done by hanging the ear-tube on the lever hook, or the Bell receiver, should that be used instead of the electro-magnetic one. In coupling the instrument, the *L* of one is connected with the *E* of the other. The transmitter *T*, swings on two small brackets inside the front, and contact is made at *J* and *K* when the front is closed. The carbon cups are made out of ½ in. carbon, and is best done with a rose countersink, large enough to take half the ball without touching the head of the screw which secures the cup in its place, or the cup may be glued in its place, contact being made by twisting a wire round the outside ; the discs are made with slices of carbon pencil, with a groove round them to have wire twisted, and when the balls are screwed up in the case, they should be quite free to rattle. The cups should be arranged 1 in. apart. An old saw and a file will do all the cutting and shaping, and if you have no lathe, a brace will answer the purpose. In the receiver, a bundle of iron wires takes the place of the permanent magnet, which was devised to meet the case of "Bell's" disclaimer, in which he disclaims a magnet excited by a battery in the line circuit. The adjustment of the diaphragm has to be made before finally screwing up, and will give no trouble if you observe to file the faces of the body of receiver, and the core, a dead level. Then cut a ring of stout writing paper, with the hole about 2 in.; glue one on each side, and when the ferrotype plates are laid on, they will be the right distance from magnet, and may be screwed up. In conclusion I would observe that the instruments switched in this manner are as loud as any made: but they can only be used in pairs, unless a separate switch is used with each instrument to reverse the poles of the battery. But in order to remove that obstacle, I have discovered that if the receiver is formed of a small induction coil, instead of the simple one, then an alternating induced current is produced, without using an induction coil in the instrument. The result of this discovery will be, that any resistance in long lines may be overcome, by simply increasing the battery power to increase the power of the magnet; the induced current being proportionately strengthened.





THE *Tech*, of Dec. 6th, gives a statement of the original work done in the physical laboratory of the Massachusetts Institute of Technology, during the last year; we quote that part of the article relating to electricity:

As a result of numerous experiments on induction in telephonic circuits, Prof. Cross has found that the induction operating to produce telephonic disturbances, is almost entirely electro-dynamic.

The effect of thin sheets of tin foil, surrounding an insulated conducting wire is very slight. The diminution of inductive effect produced when a plate of metal, or a spare wire, is placed between the wires carrying the inducing and induced currents, was found to be much greater than with the foil, and also greater with the overtones of the sounds transmitted than with the fundamental. That electrostatic induction is almost ineffective, so far as producing sounds in the receiving telephone is concerned, is shown by the fact, that if a small secondary coil with a large and deep primary is held at right angles to its plane, the sound disappears; also, if the metal plate between the coils is slit radially, its effect in diminishing induction disappears.

If intermittent or variable currents are passed through a coil of wire forming a closed circuit, within which a second closed parallel coil is placed, the secondary current, induced in the latter, can be investigated to a certain extent by inserting a receiving telephone in the secondary circuit. If a closed wire coil is placed near to the other coils, there is a current induced in it, which, as Henry first showed, diminishes the strength of the current in the secondary coil. A heavy sheet of metal, as of brass, placed between the primary and secondary coils, also diminishes the current in the secondary for the same reason. Hence, in both of these cases, the sound produced in the telephone by induction is considerably reduced.

The effect of brass, copper, and iron is very marked. Lead, also, contrary to an opinion that has been advanced, exerts a very decided effect. Thin foil, even if it completely envelops the secondary, produces but slight effect. The application of these important results to telephonic cables is obvious.

If, instead of being placed in a simple secondary coil, the telephone is placed in a double circuit of twisted wires, so arranged that the current induced in these will be in opposite directions, complete neutralization of currents is produced, and consequently cessation of sound.

Various other experiments have been performed to test the value of different "anti-induction" devices.

Prof. Cross has also found that a Hughes microphone, and a Blake transmitter, were capable of transmitting the sound of a high pitch bar giving 12,000 double vibrations per second, thus showing the excessive

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sensitiveness of the ordinary hand receiving telephone. If the capacity of the line were increased, it was found that its ability to transmit high vibrations was diminished. These experiments also showed that change in quality in the sounds transmitted is not due, as has been stated, to an inability of the microphone, or any part of this circuit, to respond rapidly enough to their higher overtones.

CHEMICAL APPLICATION OF ELECTRICITY.

(*From the Revue Industrielle.*)

OUTSIDE of the galvanoplastic applications of electricity, no attempts seem to have been been hitherto made to utilize the electric current in the reactions of industrial chemistry. Electricians have almost confined their researches to the purposes of illumination, and the transmission of force to a distance, perhaps, because it is easier to strike the imagination of the public under these forms. At the same time there is every reason for supposing that the manufacture of chemical products will not fail to profit by recent discoveries, and that great changes in manufacturing methods will be effected by these new aids. Such laboratory experiments as the decomposition of salts, will, one day, enter into practical manufacture, and render it possible to simplify a costly and cumbersome *material*. The direct production at once of acids and salts will perhaps be realized on a large scale by means of electricity.

Although great sacrifices of time and money may be essential to this realization, there is nothing unreasonable in entertaining such hopes, when we look at the progress that is being made every day, and earnest efforts to this effect are being made abroad.

An item of news, that promises to be of the highest importance in the chemical industry, comes to us from Glasgow University. Dr. Dobbie and Mr. Hutcheson, assistants to the professor of chemistry, have been studying the effects of the passage of an electric current through a solution of common salt. They found that hypo-chlorite of soda was formed. If the solution is neuter, a part of the chlorine is liberated during the passage of the current, and at the same time, hypo-chlorite of soda, which remains undecomposed in the solution, is formed. If the solution is alkaline, the solality of the chloride of sodium seems to be converted into hypo-chlorite, and if it is acid, the hypo-chlorite is immediately decomposed after its formation, the chlorine is liberated, and no more hypo-chlorite remains.

Dobbie and Hutcheson have endeavored to apply their discovery to the production of chlorine for bleaching, and they have been so successful that the process has been tried in a cotton print establishment. The cloth, after being treated with a solution of salt and water, is passed between two carbon cylinders, joined respectively to the two poles of a battery. The current passes through the wet cloth, in the fibre of which, according as the solution is alkaline or acid, hypo-chlorite of soda or chlorine is formed. In the first case a new acidification must be given for the purpose of bleaching; in the latter case the action is immediate. The pieces of cloth are printed by means of cylinders, on which resists are made with an insulating varnish, and thus the current passes only on the parts of the cylinder that are bare.

A great advantage in this process is, that the preparatory washing and scouring of the unbleached cloth may be dispensed with, in a certain degree. The electric current itself facilitates the division, and consequently the carrying off of the resinous matter in the organic fibre. The process should not, however, be further introduced until it is proved that it is commercially practical, but if reports are to be believed, there are great reasons to consider that the methods of bleaching, ordinarily followed, can be greatly modified by electricity.

In another line, we should mention the works of Messrs. Blast and Miest, who claim to have discovered a cheap process of extracting the precious metals from their ores by electrolysis. It consists in substituting plates of compressed sulphureous ore for the negative electrode of electrolytic baths—the salt of the bath having the same metallic base as the metal of the ore. An electric current passing through the bath decomposes the negative electrode, liberating the sulphur which is deposed at the bottom of the vat, while the metal goes to the positive electrode. The metal is thus extracted first from the solution of the bath, which is, however, renewed by the decomposition of the ore of the negative electrode, until complete exhaustion. If the sulphides, or sub-sulphides, contain several metals, it is then necessary to separate these minerals, which is done by the aid of a second or third electric bath.

UTILIZING THE TIDES.

THE use of water as a motive power is, of course, nothing new, but great curiosity has been lately excited by a project, for turning the immense motive power of Niagara Falls to account, and distributing it by means of electricity over a large area. It is one of the peculiarities of electricity, that while it is always able to give, it is always ready to borrow, and, in fact, it would almost seem, that its *rôle* is protean. In this connection it will be interesting to hear of the project of a Frenchman—M. V. Gauchez, for making the motion of the ocean itself a handmaid of electricity. A French writer puts this so well, that we cannot do better than translate his remarks. "The ocean forms an immense reservoir of motive power—the greatest, perhaps, in Nature, but whose energies are wasted. The incessant agitation of its waves, and the oscillation of the tides, are absorbed in polishing the pebbles that are cast on its shores, or modifying at most, the outlines of the coast that they beat against. But here is an enormous power which presents itself, gratuitously, as it were, for it comes from the sun, like everything that we receive, for even coal itself, represents nothing but the solar heat that has been accumulated during ages. The motive power of the sea, like that of running streams, has been the objective point of many inventors, but hitherto no really practical apparatus had been invented for the purpose, while the success of the steam engine completely turned the attention of inventive minds from the question. Still, the steam engine is far from being an economical apparatus, or, even one that is in conformity with the laws of rational mechanism. It cannot be gainsaid that there is a regular waste of power by its use, as not more than ten per cent. of the motive effort expended, is realized. Nor is there any reason to hope for an improvement in this respect, as the maximum theoretical return, determined by the physical properties of steam, is limited to about 20 per cent. The improvements that have been lately made in electric machines, evokes renewed attention to this question of the economic production of force, and now that we possess an intermediary that can transform and utilize at a distance the motions produced by all kinds of appliances; electric motors must in the end dethrone the steam engine, if they can do work without deriving the motive power from it.

The utilization of natural forces is, therefore, destined to play a great part in mechanics, and there is every reason to believe, that the question will receive a definite solution in the near future.

In this connection some details of recent experiments, and more especially of the apparatus of M. Victor Gauchez, which was exhibited at the Brussels Exposition of 1880, will be of interest.

M. de Coligny, the predecessor of M. Gauchez in this line, had succeeded in making use of the oscillatory motion of the sea to raise to a certain height from the water, and the apparatus which he invented was successfully used in draining the lakes bordering on the coast. He simply utilizes the elevation of the level which the water takes when an oscillatory movement is imparted to it, or the "stroke" which is given when a current is suddenly interrupted. If properly handled, his apparatus can economize a volume of water equal to 70 per cent. of the waste of an

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ordinary sluice, and sometimes even up to 90 per cent., as has been shown by experiments on a sluice in the vicinity of Fourchambault.

Some experiments have also been made with the view of directly utilizing the rising and falling motion of the tides, by storing up the water at high tide in large reservoirs and then by allowing it to flow out at low tide. A mill, with eight runs, has been worked in Finisterre by this method—one, by the way, which, under a different form, has been applied at Alexandria, in Egypt. Attempts to compress the air in large submerged bells, which would be filled with water at high tide, have also been made, but without much success.

But leaving tides out of the question, the very motion of the waves on the surface of the sea, may be made use of. In this case, the requisite apparatus must be put up at a certain distance from the shore, so as not to be subjected to the tides, while on the other hand, the force obtained becomes variable—since it equally depends on the simple swell that but ruffles the surface, to the furious wave that rises to many feet in height, and upsets boats. But this undulatory motion of the wave is easily caught, as it were. It is propagated, in fact, under the same conditions as sound or light, that is, the molecules of water—like the molecules of air or ether—are alternately raised or lowered, without any longitudinal change. It can be easily observed that a light object floating on the surface of the sea does not change its place. This being established, a simple oscillatory float at the end of a lever can be easily placed. The shaft connected with the lever will thus receive a rotatory motion.

This idea, which had been previously brought forward by M. Roche, of Nuires, who, in fact, made some experiments in the matter on the Mediterranean, has been taken up on a more general line by M. Gauchez, in the apparatus, shown in cuts 1 and 2, by employing compressed air which is stored up in reservoirs, and afterwards supplied on demand. This arrangement has the advantage of storing up force and forestalling stoppages, and it would appear, moreover, that ordinary mechanical transmitting agents would soon be destroyed by the violence of the shocks.

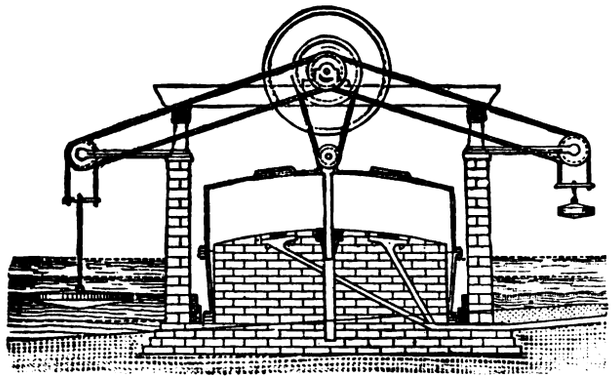

FIG. 1.

The apparatus is composed of a submerged float weighing from 110,000 to 220,000 pounds, according to dimensions, and of a compressor iron bell, which is connected with the float by ropes wound round pulleys, as shown in cut 1, and of air reservoirs which have a pressure as high as 55 pounds. These are set up on the shore at a certain distance and connected with the compressor by special conduits (Fig. 2). The float, falls or rises with the waves, and in its downward movement it raises the bell by means of two ropes that are wound in contrary directions on the pulleys. In this movement, the bell draws in the air through the openings placed in the upper part, and when the ropes slacken, while the float rises, it falls back by its own weight and drives the exhaust air into the reservoirs. Another weight keeps the chains always at a suitable tension. The bell is closed in the lower part by an india rubber membrane which is fastened to the masonry.

FIG. 2.

The length of the chains is limited, so as only to keep up with the tide, from the half wave in a low tide to the half wave of a high tide—presuming that the greatest is not over sixteen feet. By this means the slightest swells are utilized, and the troubles that would be occasioned by abnormally high tides, are avoided.

The great difficulty presented, by this arrangement—so simple in other respects—would be to prevent an undue heating of the air, and especially to provide it a rapid flow into the reservoirs. The waves following one another every nine or ten seconds, on an average, it would be necessary to fill and completely empty the bell in that time. The originator of the system believes that the bell should have a diameter of about eighty feet, with a total height of 23 feet, and with all its appendages would weigh some 132,000 pounds. The run could be limited to some 6 feet 6 in., so as only to aspirate a volume of air of from 800 to 900 cubic metres. It would be necessary to reduce the dimensions of the orifices, in order to limit the air-holes, and to furnish the bell besides with powerful safety valves, so as to insure the passage of a portion of the air into the atmosphere, when the pressure in the reservoir would prevent the introduction of the entire volume.

We will say no more on the difficulties of execution, as a question of this nature cannot be decided by a simple calculation, and the model, which is on the scale of one-tenth, can only give an approximative idea of what the apparatus would really do. Still, there are grounds for believing that there is nothing insurmountable in these difficulties, especially in view of those successfully overcome in the great works of Mount Cenis and Saint Gothard, where compressed air was employed at equally high pressure, and probably we shall soon see the first application of the most powerful, and the most redoubtable perhaps, of natural forces in the service of industry, by means of an improved apparatus of M. Gauchez.

IMPROVEMENTS IN SECONDARY BATTERIES.

A FOREIGN journal says: "At a time when secondary batteries are beginning to find their proper level, even in the commercial world, students of this branch of electricity will read with interest, accounts of any real improvements which have been made in them.

So long ago as the year 1863, Mr. Fitzgerald described the effect of red lead in batteries, and suggested its use; but little was done with it until lately, when the Faure accumulator was introduced. Mr. Tribe, who has been engaged on a series of elaborate experiments with secondary batteries, has taken out a patent, in which he claims the employment of a negative plate, composed of, or consisting of, peroxide of lead, substantially as described.

In carrying out the invention, he employs a negative plate, consisting of peroxide of lead in a solidified or compressed condition, or in any other convenient form, the same being contained in a perforated or porous vessel or receptacle, not being a conductor, nor easily acted upon electrically; or the peroxide of lead may be either employed direct in the condition

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before mentioned; or precipitated peroxide of lead may be deposited upon the surface of the peroxide of lead. This invention may be carried into effect in the following manner:

A rectangular frame may be employed, having three sides of prepared wood, slate, porcelain, or any non-conducting substance not easily acted upon by dilute sulphuric acid. The fourth side is completed by the employment of a suitable conductor projecting out of the liquid, and insulated on those parts which are in the liquid, and not in contact with the peroxide of lead. Into, or upon this, or some equivalent form of frame, he places peroxide of lead, which, if, for example, in the form of powder, may be placed into or upon the retaining frame, and subjected to pressure. The peroxide of lead may be employed in a dry or in a moistened condition, either with water or with dilute sulphuric acid. Or one or other of the non-conducting lead compounds—such, for example, as the monoxide of lead, or the sulphate of lead—may be mixed with peroxide of lead, and be subjected to pressure in the retaining frame, and then be converted into peroxide of lead by electrolytic action; or a core of compressed peroxide of lead may be fitted into the centre of the retaining frame, and covered with some suitable lead compound, which may then be converted into peroxide of lead by electrolytic action. The negative element, when prepared, may be sheathed or inclosed in artificial or vegetable parchment, felt, porous earthenware, or other equivalent materials.

When the negative plates, composed of peroxide of lead, are employed in secondary batteries, the positive plates employed therewith, may be of any suitable element, and the exciting liquids or electrolytes may be similar to those now employed in secondary batteries.

Mr. W. B. Brain, of Cinderford, patents a method of constructing secondary batteries of a thin strip of lead, folded up with a band of porous material, coated on both sides with red lead. The porous material may be asbestos, felt, spongy india-rubber, flannel, etc. The lead is poured into chambers, bags, or closed envelopes, which hold the oxydizing and deoxydizing agent, and holes are punched through from each side roughly, the burred edge and the bulging on the punched side serving to keep the red lead within the envelope, and in metallic contact with the lead walls, which are thus rendered more rigid.

A greater departure has been made by M. de Lalande, who, in conjunction with M. G. Chaperon, of the Mines d'Alonso, Spain, has patented a new battery in which oxide of copper is the depolarizing agent. The negative element is formed of a rod of gas carbon in a porous cell, packed with pieces of carbons, the interstices being filled with oxide of copper. The positive element is of zinc, in a solution of caustic soda or potash. This arrangement is intended for use as a primary battery, but it may be employed as a secondary. Mr. Brush, of Cleveland, Ohio, has obtained an American patent for a secondary battery, in which the plates are formed with receptacles for the oxide of lead, which is compressed after filling.

From these selections, it will be understood that recent improvements follow rather the endeavor to hit upon the best shape to work up the lead and its peroxide into convenient forms, than to discover other combinations more efficient and less troublesome, if more costly, than the received designs. Meantime, it is worthy of note, that in several cases the simple Planté is preferred.

*DETECTION BY ELECTRICITY OF THE ANNUAL CULMINATIONS OF THE SOLAR INFLUENCE ON ORGANISMS.**

BY NILS KOLKIN.

IT came to my notice, several years ago, that if one end of a hair or thread were tied to a watch key, or some similar object, and a person, seated comfortably before a table, with his elbow resting on the same, took hold of the other end, so as to raise the key from the table and keep it suspended, it was impossible to keep it still, in spite of all precautions. Oscillations would begin which, if the hands were warm, would attain great violence. If the key were permitted to strike against anything except glass, silk, dry rusty iron, or other bad conductors of electricity, the oscillations would be interrupted by short pauses occurring at regular intervals; and the strokes between these pauses would correspond with the age of the hair, or, more correctly, their number would show how many years old the person was when he lost it. I understood that these oscillations were caused by electricity; that the key was positively or negatively charged and repelled by the arm and hand, which were similarly charged.

I have since investigated this phenomenon, as much as my time has allowed, and I shall here carefully give the results of my experiments. I have also substituted electricity from other sources than that used in those primitive experiments, and when I have not met the same success it is due to the fact that I am not a practical electrician.

There is no known principle that accounts for the pauses in the oscillations. But the explanation seems to be that—When any organic substance is continually charged by positive or negative electricity, and discharged in rapid succession, under certain circumstances, the substance itself, and things in contact with it, will, after a certain number of discharges, for a moment become non-conductors; and the number of those discharges will correspond to the age of the vegetable or animal from which the substance is derived. I say "under certain circumstances," for I do not know whether repulsion and attraction is necessary or not. My experiments have always been with a suspended key, except with a metallic spring, placed horizontally, which is virtually the same thing. The resistance to electricity during the pause is, indeed, very slight; it does not take a very powerful charge to overcome it. The weaker the supply of electricity the better it is. Shortening the fibre by which the key is suspended will give the best results. It will make the oscillations more rapid, and they ought to be rapid enough to make it necessary to count them by twos, for the pause will thus be better noticed.

All organic substances possess this age-telling property, except absolute non-conductors, as silk. If substances of different ages are used together the age of the oldest only is shown. This fact makes it possible to find the age of substances of all forms, even with a suspended key. A fibre of an annual plant may be used, and any dry substance tied in it: in case of liquids, the fibre may be saturated with them. Liquids are good conductors, and must be guarded against. The smallest particle of juice, or sweat, or anything, when of higher age, will show its presence.

The age of a substance here must not be taken to mean the time it has existed as such, but that age which the vegetable or animal that may be its source had when its connection with that source was severed. A leaf may be two months old, but it shows the age of the tree; a drop of milk, that of the cow. I have permitted myself to call this "organic age;" but as we have nothing to do with any other kind here the word "age" must always be taken in this sense. Any part of an organism—any seed, fruit, secretion, or any part of product whatever—has the same organic age as its source. The age of vegetables counts from the time they sprang from seed. Those propagated from roots or cuttings have the age as the original. A potato showed between 800 and 900 years. The age of animals corresponds with what is commonly termed so; but new-born young have the same organic age as the mother.

This age-telling property of organisms does not seem to be destroyed by time. To what extent chemical change does it I cannot say. Considerably decayed wood retains it. Some kerosene, which caused the discovery of the age-telling property of liquids, showed constantly eight years; but this might have been due to some foreign substance.

It is, of course, plain to all that the interruption of the oscillations has nothing to do with our civil year as it is divided off in the almanac, but with a natural year. A natural year in our zone consists of an increase, a culmination, and a decrease of the solar influence. It is the number of those annual culminations to which an organism has been exposed during life that is shown. In case of annual plants, grown during the increase or decrease, they will show a year though they have not been exposed to the maximum influence of the sun. So with animals less than a year old. The oscillations generally cease very abruptly, but when a considerable fraction of a year remains uncounted there is often a gradual subsidence into a pause. How it is with organisms under the equator, where the sun passes twice a year, I do not know. But a knowledge of it would throw some light on this question.

That the sun has great influence on plants all know; but that it should have so great an influence on animals that each annual increase, culmination, and decrease of that influence should be registered in their organisms will seem to many a great heresy. The sun, however, has more power than is generally supposed. Many persons will know that they do not feel the same under its decrease and increase. They do not seem to be the same persons in the autumn and in the spring, everything else being equal. The influence of the sun prevades all Nature, and reaches life, both animal and vegetable, in recesses completely hidden from its rays.

* Read at the Montreal Meeting of the American Association for the Advancement of Science.

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THE ELECTRICIAN.

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THE ELECTRIC LIGHTING OF MILLS.

AFTER serving for a generation in the laboratory and the class-room for instruction in the laws of physics, the electric light was devoted to the spectacular purposes of extraordinary forms of advertising. The only and original circus, the opposition line of excursion steamers, and the store of wondrous bargains, were wont to use the electric light as a link in their logical chain to prove their claims upon public patronage.

Now that it is well past the experimental stage, electric lighting is recognized for its merits, and becoming one of the necessities of civilization.

At the recent meeting of the New England Cotton Manufacturers Association, much of the time was devoted to the consideration of the value of electricity in its applications for lighting textile mills.

This organization is composed of owners, treasurers, agents and superintendents of cotton mills, and other allied industries, and hold meetings semi-annually for the purpose of considering matters of importance in their work. These sessions are especially practical in their nature; everything being appraised according to the value of its application. That the governing board of such a society should choose electric lighting as one of the subjects for the session, shows the extent to which its importance is recognized.

None of the papers were electrical, but all showed an accurate knowledge of the applications of electricity. Instead of the units fixed by the Electrical Congress, dollars and cents were the standards referred to; and due consideration was given to what one speaker termed "the more valuable collateral advantages of the electric light."

Space will not permit a full resumé of the proceedings, and detailed reports of the transactions have already been given in our textile and mechanical contemporaries.* but the remarks of the different speakers were of so much interest, that we cannot refrain from giving brief extracts of them:

Mr. Kilburn, a manufacturer of New Bedford, regarded the light as a very desirable one, and said, "that his folks were anxious to get it into their mills."

Mr. Lippitt, of the Globe Yarn Mills, of Woonsocket, said, that from careful estimates, there was a saving of expense in the use of the electric light in his mills, and thought it was the general expression that the electric light was superior to almost any other known; that it was fully as safe, if not safer, than any other method of illumination; that a late fire had caused the loss of thousands of dollars by the burning off of the gas pipe; and the dangers of electric lighting could be better guarded against, than the dangers connected with any other method of lighting that he knew of."

Col. Livermore, of the Amoskeag Manufacturing Company, of Manchester, N. H., gave some statistics as to expense, which he had collected in the use of the arc light in his mills, and said: "Our experience is, that where a great deal of gas is used in a room, people hold off as long as they can, because of the heat it produces, and its vitiating effects upon the air. But they have no such scruples with the electric light, and unless people are more watchful than I have been able to be, they will find that the electric light is run more than gas would be. The saving, perhaps, will not appear in the balance sheet, but I confidently believe will appear in the quality and quantity of the work."

Mr. Ludlam, of the Merrimack Manufacturing Co., in referring to the cost of electric lighting as compared with gas, said: "If anything, the gas has a little the best of it. The *collateral advantages, however are very great.* Among these advantages are the improved quality of the atmosphere, the absence of heat, and, I think, a decided safety from fire.

As Mr. Woodbury has pointed out, electricity is like many other agencies we employ about our mills—if we do not take care of it, it will do mischief. So will steam, especially when used at a very high pressure, so will oil of vitriol and muriatic acid, which we use about the print works. I don't think, with an electric plant properly put in, that there is very much reason for apprehension on the score of danger. The first plant that was put into my mill was put in with uninsulated wires, before the underwriters had tabooed that sort of thing, and we ran it for a year or more with perfect success, and it is running there to-day."

Mr. Chas. L. Lovering, of Taunton, pronounced the electric light perfect, and said: "I did think, up to a year ago, that there was nothing to be saved in the way of expense, interest, etc., but I am rather of the opinion now that there is a saving over gas."

Mr. Edward Atkinson, President of the Boston Manufacturer's Mutual Fire Insurance Company, in speaking of the dangers of the light, said: "that their conclusions, after having delegated Mr. Woodbury to investigate the subject, to which he has devoted his whole time, has been, that the electric light of either sort is *safer than gas or oil*, but that the choice of the underwriters would be for the incandescent system rather than for the arc light system. After referring to the mechanism of different lights, he concluded his remarks by saying: "Under what has been called the *electro mania*, various substantial corporations, and many wildcat companies, have been organized. The latter have been floated at fancy prices for the stock, or at least the attempt has been made. If it were within the province of an underwriter to issue policies of insurance upon the profits which are expected, to be based upon the share of patent rights in electric lighting, held by some of these companies, I think that it would be quite safe to issue policies of a kind once offered to me when I was clerk of a manufacturing company, upon a cotton mill, which I submitted to one of the oldest stock underwriters in State Street for insurance. I submitted the plans to him and described the risk; and he cheered me by saying that he would issue a policy at a *very low rate of premium*. As the mutuals had just begun at that time, and as the stock rates were very high, I was much encouraged by this remark, and as I was preparing to draw my application, he said: 'Perhaps you misunderstood me, Mr. Atkinson; the low rate will be to give you a policy assuring you that the mill will be *consumed by fire* within a reasonable time. We cannot insure you against loss by fire at any price.' I think it would be pretty safe to issue policies assuring a large proportion of those who take stock in patent rights upon electric lighting, that they will make no profit out of them. The contest will be bitter; but the end is not far off when the manufacture of electric apparatus and the use of the electric light will come down to a commercial basis, with a fair commercial profit to the best companies making the apparatus, and a fair commercial profit to those who apply this apparatus to use.

My conclusion individually is this, that the incandescent lamp is the

* (*Cotton, Wool and Iron* (Boston), Nov. 4 and 11, have a stenographic report of the meeting.)

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true factory light of the future ; that it is the safest light which can be put into a mill ; the best light to assure perfect work ; and the best means of lighting a mill, if regard be given to the health of the operatives. As a mere matter of economy and profit, I have been assured by skilful men who have made use of the electric light in their own factories, that even if it should cost much more than gas they would not give it up, because under its use they can secure more and better work from their machinery, owing to the more vigorous condition and vitality of the operatives who attend it.

While I say that I consider the incandescent system the safest, we do not object to the use of the arc lamp under proper safeguards. I consider either better and safer than gas or oil, if put up properly and operated under constant supervision. It is not to be inferred that there is no danger of fire from the incandescent light. This force cannot be applied without danger ; but all these dangers, as Mr. Woodbury has stated, are of a sort easily avoided ; and the dangers from the incandescent system are more surely avoided than the dangers from the arc system of lighting.

In reply to a question as to whether the proportion of fires in mills lighted by electricity were not in excess of all the other fires in the same mills, Mr. Atkinson said :

The number of fires in electric plants in mills under our supervision is greater than from any single cause that has ever come under our notice in the same time. And at the same time they have led us to the conviction that they are relatively a safe kind of fire, and we have had no fire from an incandescent light, although some have occurred elsewhere. These fires have occurred under such conditions that they have all been put out without loss. There have not been many fires from the use of gas, but there has been very heavy losses from the escape of gas.

The first and most important paper read at this meeting, to which very complimentary allusion was made by most of the speakers, and to which we would direct especial attention, was by Mr. C. J. H. Woodbury, Agent for the Boston Underwriters. Mr. Woodbury, after speaking at some length upon the principles involved, the character of the light, and numerous details of expense, also the efficiency of dynamo machines and storage batteries, took up the question of the safeguards of electric lighting.

This is, we believe, the first time that anything has appeared from a responsible source upon the measure of the fire hazard due to electric lighting.

The whole principle involved in the elements of danger with strong electric currents was given in the following language :

It is sometimes assumed, by those ignorant of the facts, that electric lighting apparatus cannot set a fire. Electricity is no exception to other forms of energy. All power can be converted into heat. Your mills are equally liable to hot bearings, whether the motive power is derived from the fires under the boilers, or to the head of water in the mill pond. Whenever any one states, as a principle, that the electricity used for lighting *cannot* set fire to anything, he is not only in error, but is uttering a fallacy which will lead to the destruction of property, if carried into effect in any electric lighting system.

As a matter of assistance, in considering the question, the following record of twenty-two fires, caused by electric lighting, was given as occuring in sixty-one mills, between the autumn of 1881 and May 1882, and assignable to the following causes :

Eight were from globules of melted copper, or particles of hot carbon falling out from the bottom of the globes. The actual number of fires from this cause was probably many times this number. That class of fires will not continue to happen, as all makers now set their lamp globes in a tight stand with a ridge around the edge. A flat plate will not answer the purpose, as there was one instance where drops of melted copper rolled off and set a fire. Four fires were due to leaking water, or washing floors; and two more were caused by water, in a dye house, condensing on the building to which uninsulated wires were fastened. In most of these instances, a grounded circuit formed one of the two connections necessary to divert the electricity from the wires. Many of the lower carbons fell from lamps; and five fires were caused where they fell upon combustible material. Three fires were caused by cross arcs from one wire to another, where uninsulated wires were fastened against conductors. In one instance, the conductor was formed by dust settling upon uninsulated wires ; and on a damp day it absorbed enough moisture to form a path for the formation of a cross arc, which started a slight fire. In another instance, the wire was fastened to a damp beam which was decayed, and was burned nearly in two by the smouldering fire. And in the third instance, damp brickwork, in a tunnel, was a sufficient conductor to establish an arc, which did not do any material damage there, but injured the dynamo. Other fires, produced by cross arcs, started by water, forming a connection between two wires, have been referred to

In my connection with electric lighting matters, for the Underwriters' Union, I know of two fires, caused by improper switches : two by water, reaching the wires of a circuit already grounded, and one from wires coming in contact with a building, so that their insulation was worn away

To a superficial observer, this appears against the safety of electric lighting apparatus, but the conclusions of the speaker, whom, we presume, investigated each instance, were of a contrary nature, as he considered that everyone of these fires, in the light of present experience, could have been avoided, by anticipating their possibility, by the use of well known precautionary measures, which are summarized, as follows :

Electricity forms the safest method of illumination, when the following precautions are observed : The system insulated throughout, so that there is no electrical communication with the earth, or from one part of the apparatus to another, except through the proper conductors, even if the wires should be exposed to water. All switches made with a lapping connection, so that no arc can be formed. Arc lamps provided with globes closed underneath, and the frame so arranged that the lower carbon could not fall out, even if the clamp failed to hold it securely. The wires of incandescent systems, provided with a sufficient number of fusible links, to secure the system against any damage from an excess of current.

The carrying out of these principles, in every detail, requires careful work and constant watchfulness.

The importance of regular tests, to detect any "escapes," is urged very strongly, because there is no assurance that an electric lighting system will remain clear of all conductors, even if satisfactory when first installed.

The extreme instance of danger. from ground connections, is stated to be, that

When electric lights become dim in rainy weather, it is conclusive evidence of ground connections, which divert the electricity from the system, causing both commercial loss of electricity and great danger of fire. Two contacts are necessary to divert electricity from an electric lighting system. If one contact already exists and connects it with the earth, only one more contact is necessary to conduct a portion of the electricity from the system.

In such an event, if the electricity overcomes a conductor, of sufficiently high resistance, the electricity is converted into heat, sufficient to burn any combustible substance, which is present.

The regulations which Mr. Woodbury prepared for the Underwriters' Union, are given, and the paper concludes with the remarks :

Electric lighting should be encouraged, on account of its inherent qualities of safety. Any system that is in conformity to the insurance regulations is also in its best condition electrically.

Electricity, like all forms of energy, is dangerous to the extent that it is not held in control. The same is true of steam in boilers, or water in mill ponds. Like fire, they are all "good servants, but poor masters."

But few have had such advantages of observing the application and use of the electric light in such a large number of different establishments, and also the opportunity of special investigation in this work; and Mr. Woodbury's paper is a welcome contribution to the subject, both for the information which it contains, and the conclusions, based upon a wide field of experience.

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STORAGE BATTERIES.

THE recent exhibition of the Brush secondary battery, in this city, has again attracted public attention to the general subject of the so-called storage of electricity. The information given in regard to the construction of this battery, is of the most general character, and is entirely insufficient to enable us to form any intelligent opinion with respect to its novelty or efficiency, or, as to its chances of commercial success.

It is stated by Mr. Brush, and by those who have charge of the exhibition here, that the battery consists of lead plates, and the ordinary solution of acidulated water, and that the plates are prepared by some secret chemical process, by which greatly improved results are obtained. Very high efficiency is claimed for it in a general way, and those who are interested in it, appear to be confident that it will prove economical and reliable in use. It is to be observed, however, that similar claims were made in regard to the Faure battery and others, which have been before the public for some time, and so far as we are able to judge, from the best information accessible to us, none of these batteries have yet proved available for ordinary use, and it appears to be the better opinion that the storage system will have a much more restricted field than its advocates claim for it.

Such tests of the Faure battery, as we have seen reported, seem to indicate that a higher efficiency than 50 per cent. cannot be safely relied upon in practice. That is, only about one-half of the current expended in charging the battery can be recovered in useful work, and even this efficiency would probably be considerably impaired, unless the battery were used within a comparatively short time after charging it. Aside from the loss of current, the expense of the battery appears to be quite a serious item. Taking, for instance, the plant at the *Théâtre des Variétées*, at Paris, it is stated that 265 Swan lamps are used, and are supplied by about a hundred Faure batteries. The total weight of the batteries is stated to be fourteen tons, ten tons of which is active material.

No doubt, in certain exceptional cases, such batteries will prove extremely useful, but for general use in a system of distribution from central stations, we think, the advantages have been largely over-estimated. It is true that the conductors for distributing the current may be considerably reduced in size, but the cost of constructing and maintaining the secondary batteries, would, in a large measure, make up for this advantage, if not entirely counterbalance it. The advantages claimed by way of reducing the capacity of engines and dynamos, has also been considerably overrated. Experience seems to show that no machinery can be relied on for constant use, working anything like 24 hours a day. Considerable time must be allowed for making necessary repairs and overhauling machinery, and very reputable mechanical engineers have expressed the opinion that no practical advantage could be gained by running engines and machines more than twelve hours per day, as the increased wear and tear, and the liability of accident would counterbalance the saving in the cost of the plant.

It is obvious, also, that the introduction of the storage battery largely increases the complication of the system.

No doubt there would be considerable demand for a really efficient secondary battery for use in places where expense is not a controlling consideration, but we by no means share the sanguine views of those who believe that such a battery would effect a revolution in present methods of lighting.

—— "THIS 'LECTRIC FLUID must be a dangerous substance," said a country visitor, "see how yellow it turns the gas!"

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from page 2:0.*)

THE wire, electro-magnets, and escape wheels, just described, are used to operate the letter type wheels of the instrument. Each instrument contains another type wheel, on an independent shaft, having all of the figures and fractions necessary to be used, engraved on its periphery. This figure type wheel is operated by a separate figure wire, magnet, escapement anchor, and escape wheel, in a manner precisely similar to the letter type wheel, already described. The two type wheels revolve in planes about ⅛ inch apart, but over the same printing pad, and over the opposite margins of the same moving band of paper, which is ¾ inch wide. The figure type wheel is revolved in the same manner as the letter type wheel; *i. e.*, by pulsations produced in the relay local circuit by the revolving cylinder of the transmitter, repeated into the main circuit and reproduced on the anchor and escape wheel of the printing instrument. An inking wheel, consisting of discs of felt soaked in printing ink, and held together by ebonite flanges, revolves over each type wheel, and serves to keep the type sufficiently inked.

It now remains to show how the printing of a letter, or character, is effected.

Whenever the revolving cylinder of the transmitter, normally in motion, is stopped by the depression of a key, the vibrating-arm falls into one of the notches in the 30-toothed wheel and closes a local circuit consisting of all the printing relays of all the main circuits. A branch of the main battery for each circuit, is connected to the armature lever of each printing relay, while the main lines are connected to the lower contact points of the relays. When the two platina points are brought into contact, a current flows over the main line, actuating a separate electro-magnet, printing press, and feeding mechanism, in each instrument. It will thus be seen that each instrument consists of three integral parts, operated by three different line wires, although assembled on the same base and within the same frame. The printing mechanism consists of an armature lever constructed so as to raise an india-rubber pad, bearing the moving band of paper, against both type wheels, whenever the circuit is closed on the printing wire. The pad revolves on its own axis so as to present fresh surfaces to the type wheel with every impact. When the paper is pressed against the type wheels it receives an impression from the letter or figure on the wheel which was moved last. The other and idle wheel presents the unison dot to the paper, and the printed slip therefore presents a record of letters on the upper margin, and dots on the lower; or, dots on the upper margin and figures on the lower. The letters are always printed in one line, occupying the upper margin of the strip of paper, and the figures are always printed in a line on the lower margin of the paper, with dots opposite to each letter or figure printed. The reason for the appearance of the dots is this: the paper must strike both type wheels when it is raised, and the operator working the transmitter always takes care to rotate the type wheel used last to the unison dot, before rotating the other wheel; the downward movement of the printing press lever operates a feeding mechanism, so as to push the paper out from the machine and leave sufficient blank paper under the type wheel for the impression of another letter. The feeding mechanism is constructed as follows: an arm, independently pivoted, carries a revolving ebonite disc, which is held down firmly on the paper after it leaves the printing pad, by a spiral spring attached to the pivoted arm. This disc presses the paper upon a toothed wheel, the teeth of which cut into the paper, so that when the

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toothed wheel revolves the paper moves with it, in the direction of its revolution. The toothed wheel is on the same shaft with a fine toothed ratchet wheel, which is moved by a dog engaging in its teeth, on the downward movement of the printing lever. A pin, projecting from the side of the printing lever, works in a slot in the dog and communicates the motion from the lever to the toothed wheel. Another stationary dog, falling into the notches between the teeth of the wheel, prevents any backward motion of the feed apparatus, so that the paper cannot be dragged backward when the printing lever moves upward. The same main battery operates all three wires of the same circuit, consequently, the current is sometimes closed on two of the wires of a circuit at the same time. For instance, when the instruments are idle and ready to receive a message let us suppose that the first letter of the message to be printed is *a*. This is the second letter in the alphabet, as the (unison) dot comes first. The first wave of electricity passing over the letter wire, will cause all the letter magnets to attract their armatures, the escapement anchors to be moved downward once, and held there, and the escape and type wheels to be moved forward one tooth and one letter respectively. They must be held in this position by a prolongation of the current on the letter wire, as the act of releasing them will cause the escape and type wheels to be moved forward one tooth by the action of the retractile spring. Now, if at the moment the current is put on the letter wire, and the letter *a* brought opposite the paper, the cylinder of the transmitter be detained, the printing circuits will be closed, and the main batteries will all be split between the letter and printing wires, half of the current passing over each wire. This action takes place whenever a letter or figure, which requires a *downward* movement of the escapement anchor, is printed.

The portion of the instrument next requiring description is the automatic unison device, which operates entirely independent of the will of the operator who is transmitting the quotations. It will be remembered that each type wheel is worked by a separate wire, and revolves on an independent shaft; one of the type wheels carries, between its spokes, and on the side next to the other type wheel, a pivoted arm, normally held downward towards the hub of the wheel by a spiral spring. A boss, rigidly fixed to the frame of the machine, raises this arm up about ⅛ of an inch; when in the revolution of the wheel, the arm comes opposite the boss. The object of the boss is to prevent the arm from falling into a slot, which is carried by the other type wheel, which slot is normally opposite the arm and ready to receive it at the same moment that the arm is lifted up by the boss. Whenever one of the wheels is out of unison, that is to say, does not rest with its dot opposite to the paper while the other wheel is revolving, the result follows, that the unison arm falls into the slot, and the two wheels are thereby locked together, arm-in-arm as it were, and revolve together until the dots on both get opposite the paper, when the arm is lifted out of the slot, and the idle wheel is left stationary while the other revolves alone. It will be observed that this operation will take place equally well when either wheel is "thrown out" of unison; because, in one case, the slot moves under the arm and allows the latter to fall in; while, in the other, the arm moves over the slot and falls in. In order to facilitate the operation of this unison, the retracting spring, which produces the upward movement of the escapement levers, is one single flat steel spring pressing equally upon both escapement armatures, and in the same direction. The result is, that the wheel which is "setting" the "thrown out" wheel does not have to operate against the retracting spring of the latter, as there is but one spring, and that is pressed away from both armatures by the armature which is working. A delicate spiral spring sustains the weight of each escapement anchor, lever, and armature, so that the escapement lever of the idle wire does not fall into the notches of its escape wheel when the retracting spring is withdrawn by the working of the other wire. An additional essential part of the unison apparatus consists of an arm projecting from the side of each escapement anchor, and another arm projecting from the side of each escapement wheel shaft. When the wheel which was "thrown out" has been rotated to its proper position, the arm on the anchor catches against the arm on the escape wheel shaft, and holds the latter fixed, and it cannot be moved until the first downward movement of its own anchor releases the arm on the escape wheel shaft from the arm on the anchor. This unison operates automatically only when required, and either wheel sets the other interchangeably. The instruments, above described, have 5 ohms resistance in each magnet; and are worked in circuits containing as many as 30 instruments, and up to a maximum of about 6 miles in length. An average of 3½ cells of carbon battery, per instrument, is required; and the type wheels are rotated at the rate of 55 revolutions per minute, requiring 13.75 emissions of current per second, producing an average speed of 14 English words per minute.

In order to prevent the destructive effects of the large spark, normally produced at the relay points, condensers are used on all of the type (letter and figure) relay points. One armature of the condenser, consisting of 100 sheets of tin foil 10½in.x16½in., is connected to the main line where it leaves the relay points, while the other armature, of 100 sheets, is connected directly to the earth. The charge received by the condenser is about equal to the magneto-electric current developed in the line on the withdrawal of the battery current, by the discharge of the electro-magnets, and the two neutralize one another before the latter reaches the relay points to cause any spark there. There are 1,000 of these instruments now working, in New York City and Brooklyn, from one transmitter.

(To be continued.)

IT is not only the inventors of the world that have now turned their thoughts to electricity, but also the speculators. The progress of the practical science to that degree of industrial perfection, which will render it a paying investment from a financial point, is necessarily slow. Some companies have indeed established themselves almost at once as profitable undertakings; but the formation of large money enterprises, on the strength of inventions which are not sufficiently tested, is certain to result in disappointment. The quotations of some of the minor English companies have greatly depreciated. In fact, electricity, though a giant, is yet young and should not be made a favorite object of speculation. We are in favor of the widest freedom, so far as manufacturing enterprise is concerned, for here there is a solid basis, but the abuse of electric discoveries in England by the "promoters of the undertakings" has already thrown some discredit on solid companies. The shares of some of the branch companies that were formed have declined considerably, others have been obliged to wind up.

But whatever stock jobbing misfortunes may be reported, we have no doubt that when electricity comes to be more adapted to all industries, as it will be before long, it will then offer a large and safe field of investment.

—— MR. N. STEVENSON, of London, uses a small Swan incandescent lamp to illuminate the cavity of the mouth in dental operations. It is fitted into a vulcanite cup which acts as a prop to keep the jaws apart.

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NEW INSULATED WIRE.

AMONG the many inventions, in telegraphic and electrical apparatus, which have been brought out during the last three or four years, perhaps, none has received so much attention, as that which is intended to serve as a cheap substitute for the high priced gutta percha and rubber covered wires.

Inventors, in both Europe and America, have given much of their time and attention in seeking to produce a cheap compound, which shall embody, as nearly as possible, the good features of the above expensive wires; but many have failed in the attempt. The conditions required in a substitute, especially for ærial purposes, are: 1st, cheapness; 2d, insulation; 3d, imperviousness to moisture, or ability to resist atmospheric influences. We learn from parties, who have made a careful study of this subject, that to produce a compound complying with the above conditions, is no easy matter, especially when the question of non-inflammability is also considered, so as to include a wire suitable for electric lighting. In fact, it is found that improvements in this direction are not an exception to the general law governing similar cases; for, as the excellence of the compound is increased, whether in the matter of insuring better insulation, or ability to resist atmospheric attack, the cost is increased in the same ratio.

There are two or three new forms of insulated wires, which have come into prominence of late, on account of the large quantities which have been put up during the past two or more years; and, judging from their steady increase on poles and housetops, we are inclined to think that "they have come to stay." The first of these is the "paint wire," now seen wherever an electric light makes its appearance. This cannot be classed as a new invention, as covering of the same nature has been used for several years.

It is, however, acceptable to the Board of Fire Underwriters, on account of its non-imflammability, and is probably as cheap a covering of its kind as can be obtained. Large quantities have been put up all over the country, and its use will, no doubt, continue to be quite extensive, until a better wire is found. It is now manufactured by Holmes, Booth & Haydens' Ansonia Brass and Copper Company, and others. Another insulating covering, which has become prominent of late on account of its extended use, is the "K. K." wire, so called after its inventors, Messrs. Knudson & Kane, of this city. This wire has stood the test of atmospheric influences for two years, and so far seems to answer the general demand for a cheap and durable insulator.

The compound consists of refined mineral asphalt, combined with various oils and other ingredients, which give to it flexibility, non-volatile qualities, etc. Its water-proof qualities are far superior to either the paint or paraffine wires, and its durability in the atmosphere promises for it an important future. The iron "K. K." is extensively used by telephone, fire alarm, police, and district telegraph companies.

This branch of electrical science being one of great importance, we shall endeavor to keep our readers informed from time to time of new discoveries of value, which may make their appearance.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

VII—STATO-ELECTRICAL STORAGE.

AS the electrical machine developed, experimenters with electricity were encouraged in all directions. They most persistently endeavored to concentrate the wonderful substance and preserve it for later use, but their efforts so often resulted in novel modifications of the prime conductor only, that at last a new announcement of its successful storage was confidently expected to eventuate in a different version of the same old story.

In 1746, [1]however, a sensation, pervading all society, was created by the news that in the village of Leyden, in South Holland, the long sought object had been attained, and the mysterious fire collected in a bottle; which, from the place of its discovery, was first called the "Leyden Phial," and is now familiarly known as the "Leyden Jar."

A story so trite, that its several versions[2] are familiar remembrances of one's school days, needs no lengthy repetition. From a contemporary account,[3] in brief, it appears that Prof. Muschenbrock, and associates, suspecting the atmospherere of conveying away the electricity which electrified bodies so speedily lost, enclosed some water to be electrified, in a glass bottle, in the hope that thus protected from the air, it might be given and enabled to retain a stronger charge for a longer time.

At first they perceived no result, but on a fortunate occasion, the operator holding the bottle in one hand attempted with the other to disengage from the prime conductor of his electrical machine, the wire by which the water in it had been electrified, and he instantly experienced the convulsive shock which has since been, and is now, so often suffered from motives of curiosity, amusement, or anticipated

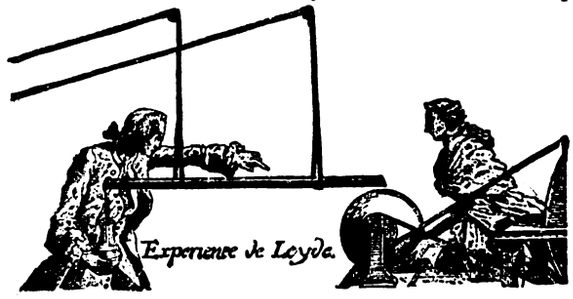

Fig. 23.

physiological benefit. From a publication of the year 1747 an illustration of this celebrated event is reproduced in Fig. 23.

Muschenbrock wrote to Reaumer a famous letter giving an account of the first shock he received, in which he says that it was two days before he recovered from the blow and terror, and that he would not take a second shock for the whole kingdom of France. Little as we now think of a shock from even a powerful Leyden jar, he was not singular in his estimate of this disagreeable sensation, for Winckler, Allamand, and many others, who immediately subjected themselves to this surprising behavior of the "accumulated electric fire," generally by removing the jar and dipping the finger in the electrified water, considered themselves as similarly affected.

The first emotions of astonishment at such a "prodigy of

1. Lardner, Cab. Encyc. London, 1841, p. 18.

2. See Muschenbrock Elem. Phys., 1748. Nollet Essai, etc. Paris 1747. Priestly Hist. of Elec. London, 1795. Lardner, Loc. Cit. Du Moncel Hist. of Elec.

3. Priestly, Loc. Cit.

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nature and philosophy" having abated, it was thoroughly investigated. Mr. Watson found that the shock could be transmitted through several persons, and that its force was greater, the thinner the glass of which the jar was made; that it was independent of the power of the machine used to electrify the water, and dependent directly on the extent of external surface of the jar covered by the hand. Dr. Bevis thereupon suspected that the hand acted merely as a conductor, and successfully substituted for it a coating of tin foil, thus giving to the Leyden phial, externally, the appearance it still preserves. Soon afterward, conjecturing that the function of the water in its interior was similar, and thinking that metal should be more effectual, he filled three phials with shot instead of water, and obtained a shock which seemed of remarkable intensity. His Leyden phial, thus derived, and called the Bevis jar, is still popular, but is usually filled with crumpled metal foil instead of shot as

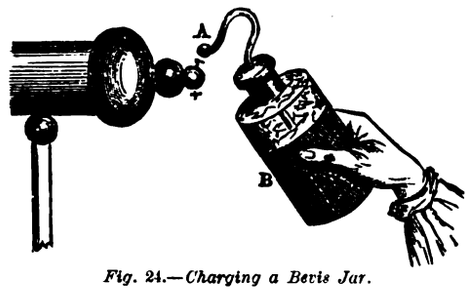

Fig. 24.—Charging a Bevis Jar.

shown in Fig. 24. His combination of phials is now called a Leyden battery, and in its modern form is shown in Fig. 25.

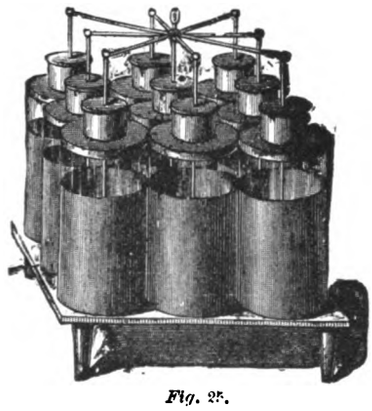

Fig. 25.

These conjectures having proved true, Dr. Bevis realized that the phial shape had no connection whatever with the phenomenon; and having coated a flat pane of glass nearly to its edges with tin foil, it gave him a spark or shock as powerful as would be given by a bottle of equal area. Such a plate, vertically mounted, is called a Bevis plate, and a number of them combined, constitute a most powerful battery.

The Bevis plate was a favorite form of the Leyden jar with Mr. Benjamin Franklin, who, later, discovered it independently, and who contrived an amusing modification of it that he called the magical picture. He says: "The coatings being concealed beneath the parts of an engraving, suppose of the King (God preserve him)! let the picture moderately electrified, be held with one hand by a person who shall attempt to remove the crown from the King's head with the other. He will receive a terrible blow and fail in the attempt; and, if the picture were highly charged, the consequence might be as fatal as that of high treason for the spark makes a hole through a quire of paper which is thought good armor against a bullet, and its crack is exceeding loud," but, he adds in a note: "a hen is the largest animal we have killed by it." A form of the device called the "miser's plate," is shown in Fig. 26. Informed

Fig. 26.—Miser's Plate.

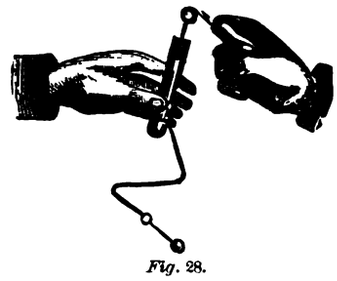

Fig. 28.

of its success, Dr. Watson coated large thin jars, both internally and externally with silver leaf, and thus finally established the well known form of the common Leyden jar. Fig. 27

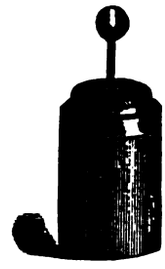

Fig. 27.—Watson's Leyden Jar.

Wilson, Canton, Franklin, and Nollet, also discovered many of these facts, and others; which led to the inference, that in the discharge of a jar, the electricity traversed a circle of conducting matter from its inside to its outside coating. Thus, in Figs 23 and 28, which show the earliest and latest methods of taking the shock, the arms and body of the subject form the conducting circuit. Dr. Watson, by a celebrated experiment, proved that this circuit might include miles of wire, and observers at its opposite extremities; yet both would receive the shock apparently at the same instant.

Not, however, until Benjamin Franklin devoted his clear mind to the analysis of its phenomena, was the mode of operation of the Leyden jar comprehended. He first showed that the inside and outside were oppositely electrified, and invented a semi-circular wire with a handle of sealing wax, which he touched to the "hook" and outer coating respectively, of an insulated jar, and thereby discharged it, thus proving that no electricity passed in the discharge of a jar except from one coating to the other. Franklin's wire has become the discharger, Fig, 29, and the manner of using it is shown in Fig. 30.

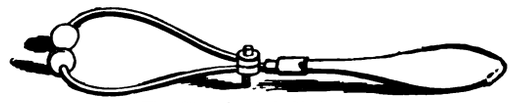

Fig. 29.—Jointed Discharger.

But to further demonstate that the inside and outside were oppositely electrified, Franklin tried other famous experiments, A metallic ball, communicating with the external coating of a jar, was placed near the one communicating with its interior, "a cork ball suspended between these two knobs swung incessantly from one to the other;" that is, "it fetched and carried fire from the inside to the outside of the bottle, till the equilibrium was restored." Or, the silk thread being fine to imitate a web, he says, "we suspend upon it (instead of the little sphere) a counterfeit spider made of burnt cork, with legs of linen thread, and a grain of lead stuck in him to give him more weight. He will immediately fly from one ball to the other, playing with his legs against them in a very entertaining manner, for an hour or more, in dry weather, and appear perfectly alive to persons unacquainted."

Fig. 30.

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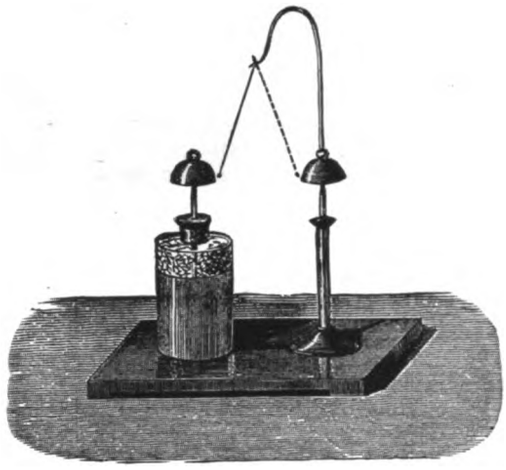

Fig. 31.—Alternate Discharge.

As an adaptation of the electrical chimes, Fig. 31, this application of the pendulum is still in vogue for illustrating the principle of alternate discharge; but Franklin's most ingenious invention, described for this purpose in 1748, was the electrical jack,[4] a circular Bevis plate, mounted horizontally on a vertical axis, having little balls at equal distances upon its circumference, and connected alternately with its opposite coatings, and caused to revolve by the attraction and repulsion between these balls, and an equal number fixed closed to its edge upon columns in a circle around it. For this wheel, revolving with astounding velocity, Franklin anticipated many practical applications, but not one has yet been devised.

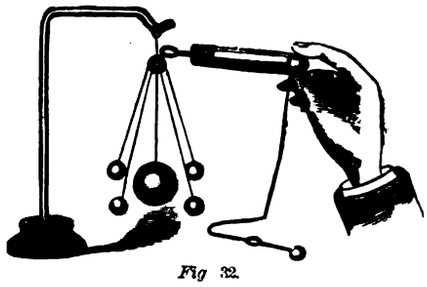

Fig 32.

The electricity upon either coating of a jar, was shown by the repulsion of pith balls, as in the modern arrangement, Fig. 32;[5] and later, by the repulsion of the pith birds, in the

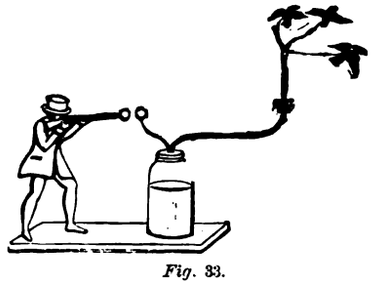

Fig. 33.

now well-known device of the electrical sportsman, Fig. 31; and the precise equality of the opposite electricities accummulated by their complete collapse upon the discharge of the jar. In the latter case, the gun of the metal sportsman forms part of the conductor, and by its apparent discharge the entire flock is brought down.

4 Franklin's Life, by Jared Sparks. Letters. Vol. 5, p. 206. Marquis de Courtanvaux on Franklin's Electrical Wheel. Journ. de Phys. Vol. III., p. 272. Pl. I.

5 Due to Mr. Curt W. Meyer.

UNDERGROUND CABLES.

To the Editor of the Electrician:

ONE of the most interesting features of modern telephone line constructing, is the laying of underground cables. On account of the rapidly increasing number of air lines in large cities, the laying of underground cables will soon become the rule instead of the exception.

A three and one-half mile cable has recently been laid in Boston. This cable was composed of three gutta-percha covered conductors of No. 18 copper wire, around which 13 hempen cord wire wound spirally, and the whole covered by a paraffined hemp tape, two inches wide, also wound spirally, so that the edges overlaid each other about ¼ of an inch.

An iron pipe was laid at the depth of about two feet, through which an iron wire had been run to be used to pull the cable through by. At about every 700 feet along this pipe, wooden boxes were placed for convenience in testing, and also to make the splices in, when the cable had to be cut.

The reel, containing about 1¾ tons of cable, was placed at the end of the pipe, the cable spliced to the iron wire, and pulled through the first 1700 feet without difficulty. The cable was then cut, and the reel moved to the next section. The longest length pulled in without cutting was 2,250 feet.

A curious thing was noticed in testing (by telephone). When two wires of the cable were used, making a metallic circuit, no disturbance from induction was noticed; but, when only one wire was used, using the ground for return, the continuous clatter of telegraph instruments, and occasionally faint talking could be heard. On one occasion the words "Hello, Jim," were distinctly heard at both ends of the line. The line is now in good working order.

Boston, December, 1882.

A SUBSCRIBER.

THE SPARK.

THE Spark is a small, simple electric generator, capable of various adaptations, such as a lighter for gas or spirit lamps, as a medical apparatus, as an amusing physical apparatus, as an electric bell generator, etc., etc.

In construction it partakes of the character of both the magneto-electric and the dynamo-electric machine. It consists chiefly of a horse-shoe magnet, which serves also as a handle, between the poles of which a little Siemens armature may be rapidly rotated by means of a crank and train of cog-wheels. The currents developed in this armature, and collected by a Clark commutator, traverse fixed coils placed upon the branches of the magnet, and act to reinforce its magnetism; thereby not only augmenting the power of the magnet, but also keeping it saturated. By the rotation of the crank the circuit is broken and powerful induction currents produced, and consequently very hot sparks, which easily ignite a spirit or gas lamp placed suitably near the eccentric which breaks the current. The same apparatus, slightly modified in form, may be used in connection with gas or petroleum vapor engines to ignite the explosive mixture.

The apparatus is completed for medical use by a little induction coil contained in the bottom of the case. The number and power of the shocks is regulated by the rapidity with which the crank is turned. The same coil will also operate Geissler tubes and a series of experimental or entertaining apparatus. It is a great advantage to be able to provide young people with such a source of instruction and entertainment, and yet avoid the use of bat-

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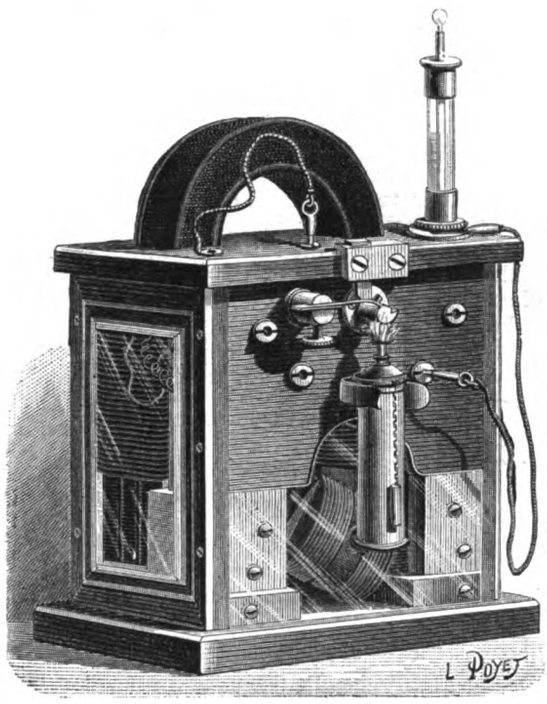

teries and acids, for care and precaution are by no means qualities that they largely exercise.

Because of the various applications of which it is capable we have thought it useful to describe this little apparatus.

A NOVEL CONDENSER.

THE agent of a Massachusetts cotton mill, when about to make a personal examination of some matters relative to the water power, had put on his rubber leggins, when the treasurer made his appearance, and was escorted through the mills. After standing under a large belt for a few minutes, the agent touched the treasurer's shoulder, and gave him an electric shock, which nearly overturned the man of money. The rubber boots, and the man inside of them, formed a large Leyden jar, whose discharge was very severe, especially to a person expecting nothing of the kind.

NEW INSTRUMENTS FOR MEDICAL AND SURGICAL APPLICATIONS OF THE ELECTRIC CURRENT.

DOCTOR BOUDET, of Paris, has published in the "Medical Review" a very good series of articles upon the application of electricity to the diagnosis and treatment of diseases; and it is to be desired that he will extend them to a work which may be widely circulated and serve as a "*vade mecum*" for all physicians who profess to occupy themselves with electricity; not that these articles could replace exactly a treatise on "Electropathy," but they would constitute a good foundation for the study of the subject, and advantageously replace the preliminary considerations which constitute the usually worthless introductory chapters to all works on medical electricity.

We wish not to convey the impression that these articles are beyond criticism in certain of their minor details, but to call attention to the new contrivances described by Dr. Boudet as appropriate for certain specified cases which, it seems to us, must render valuable service.

I.

The employment of electricity to produce thermic effects has been already frequently resorted to[1] with advantage; but it is not the effects of galvano-cautery, but those of revulsion that are first presented to our attention. These are usually obtained by separate discs or pads, that are applied upon two distant parts of the body. From this usual disposition arises the following inconveniences: the tissues interposed between the two pads are all submitted to the action of the electric current; and it is possible for derivations to occur within the organism, which may produce, in certain cases, most disastrous or unnecessary results, as for instance, in cases when the operation is performed in the vicinity of *nervous* centres; further, an intense physiological action occurs at the moment of rupture, which is as much more intense as the Thermic effect is energetic, and consequently painful, and which may cause an abrupt interruption of the operation.

The apparatus proposed by Dr. Boudet, and of which he claims to make use with advantage, is composed of two concentric metal plates insulated from each other, the interior plate being a circular disc, and the exterior a circular ring. They are of about the same area, and are mounted upon a plate of ebonite which insulates and maintains them in position. In the centre of the apparatus is a wooden handle provided with a binding post which is in metallic communication with the central disc, while a second similar binding post is fixed in metallic contact with the periphery of the exterior ring. To these binding posts the battery terminals are fastened. It is shown in Fig. 1.

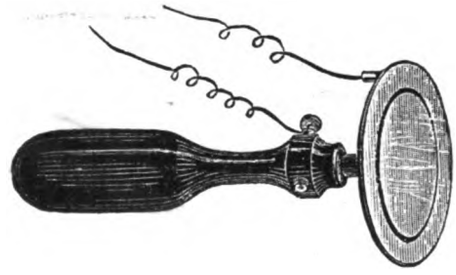

FIG. 1.—GALVANO-THERMIQUE EXCITER.

It is clear that with this device, the action must be localized at the region where it is required; and the derivations are reduced to a minimum.

The Dr. says, by varying the intensity of the current, all the degrees of revulsion can be produced upon humid integuments from that of a mustard plaster, to the formation of instantaneous blisters.

When the action is thus energetic, its duration must be strictly limited to 1 or 2 seconds.

We regret that the Dr., who himself complains of the uselessness of the terms "weak current," or "intense current," has not furnished, in this case at least, an approximate indication of the measure of the intensity of a current capable of producing such, or such an effect. Such an omission is surprising.

II.

A fundamentally, analogous arrangement, rendered necessary by the same causes, has been applied to the localization of the electrolytic action of the current, to avoid the effects of derivation. The apparatus, Fig. 2, comprises an insulating handle, which bears two insulated metal pieces, one carrying a metallic ring, and the other, supporting in its centre, a steel needle, a conical nickel-plated point, or a pad of carbon, covered with chamois or other suitable skin.

1 Fourcadi. Paris, 1882.

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These two parts communicate, separately, with the two poles of the battery, the active pole being in relation with the central piece.

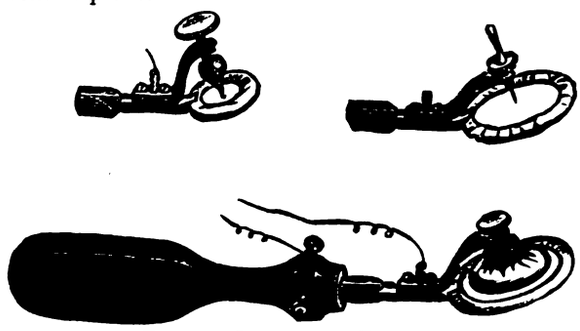

FIG. 2.—CONCENTRIC EXCITER.

This apparatus, under various forms, has been already utilized, for galvanizing the nerves or muscles of the face; for electrolizing erectile and ganglionous tumors, and even for the electrolizing of tumors of the aorta. The observations of Dr. Boudet, indicate that derived currents are effectually avoided. The intensity of the current varies from 12 to 15 milliampéres (destruction of the chalazions), up to 45 milliampéres (aneurism of the aorta).

III.

In other cases, on the contrary, the diffusion of the current in such a manner as to distribute its action over the largest possible surface is the object to be attained. It would be useless to occupy ourselves here, with the well known methods which are employed when this diffusion is to be produced simply on the surface of the body. But difficulties present themselves when it is desired to operate, upon the sides of certain cavities, such as the intestines, the bladder, etc. Contact, with the mucous, of a metallic instrument conveying an electric current, would cause burns, and produce serious accidents. Dr. Boudet avoids all difficulty, by the simple and ingenious method of charging the cavity with a liquid conductor, to diffuse the current to all the points that it reaches.

The apparatus comprises a hard rubber probe, larger or smaller, according to the purpose for which it is designed; in the interior of which is introduced, either a tubular metallic mandril; or, (in case the probe is to be inserted in the bladder) through the canal of the urethra, simply a platinum wire.

This tube, or this wire, is chosen of such a length that its end does not quite reach the first eye of the probe, and it is, therefore, impossible for a metallic contact with the membranes to occur. This metallic conductor is put in communication with the — pole of the battery; whilst the + pole communicates with a very large plate of metal, covered with wet chamois skin, according to the indications, is applied either to the dorsal or abdominal regions. At the same time, salt water is injected in the probe by the aid of a syringe, and the salt water filling the intestines, or the bladder, is traversed by the current on its way from one pole to the other, which acts, therefore, at all points of contact between the electrolyte and the tissues.

In the case of the bladder apparatus, a manometre is added, which indicates the slightest contraction of the bladder.

The electrization of the intestines has been applied especially in cases of intestinal occlusion, and the doctor records 19 successful cases out of 31 observations. The currents of 40 milliampères can be employed without inconvenience, and in certain cases their action can be prolonged for hours.

We have described these instruments in detail, because they seem well contrived and susceptible of being advantageously employed in practice.

C. M. GARIEL, in *L'Electricien.*

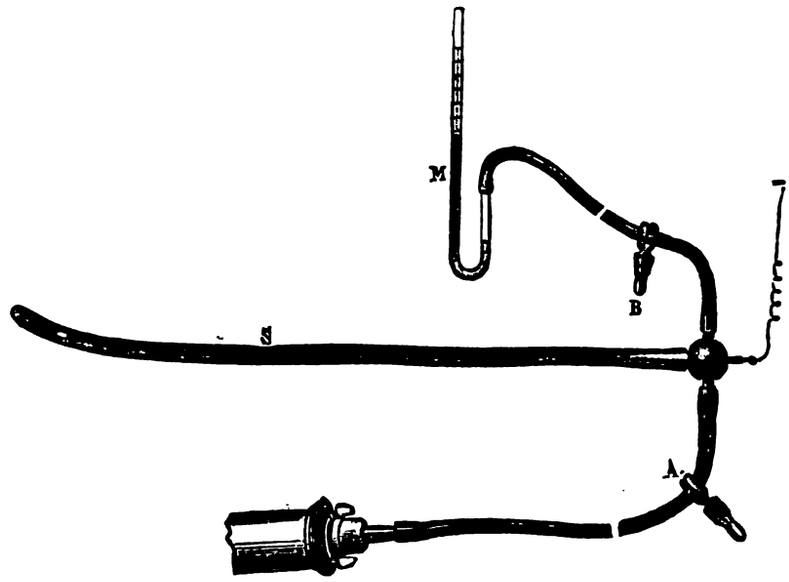

FIG. 3.—INSTRUMENT FOR BLADDER.

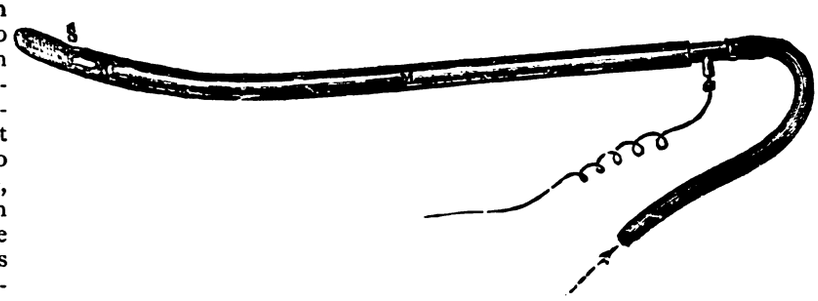

FIG. 4.—INSTRUMENT FOR INTESTINES.

A TELEPHONE supplied with a Faure secondary battery is much more perfect in its operation, than when a battery is used in the ordinary manner. The reason is supposed to lie in the fact that the secondary current is much more uniform than the current supplied by a battery. Conversation can easily be carried on with the speaker twenty feet from the transmitter.

—— M. MARCEL DEPREZ'S statements, as to the energy transmitted by electricity over an ordinary telegraph wire between Miesbach and Munich, are criticised by M. Hospitalier and others. M. Deprez claimed a return of 60 per cent.; but such a result is found to be impossible under the most favorable conditions as to insulation. M. Deprez calculates that the return is equal to the ratio of the speed, where the dynamo machines are exactly alike. M. Cabanellas has recently presented to the Academy of Sciences, of Paris, a paper, in which he holds that "in the transmission of mechanical energy by means of two identical dynamo-electric machines, the ratio of the speeds does not express the value of the return. The return is equal to the product of the ratio of the speeds into the ratio of the fields"—a theory which tends to show that only 20 per cent., instead of 60, was returned in the experiments of M. Marcel Deprez.

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PRACTICAL FORMULAS FOR BATTERIES USED WITH INCANDESCENT LAMPS.

To the Electrician:

THE following formulas and example are taken from a paper by E. Hospitalier, in *L'Electricien*, of 15 June, 1882.

Let i' be the intensity of current required in each lamp to keep it white hot; let e' be the difference of potential and r' the resistance between the binding screws of each lamp, while in use. The resistance, when hot, may be roughly considered as one-half that found when cold. If we have n' lamps connected in multiple arc, the current necessary to supply them will be:

$$I = n'i' \qquad (1)$$

Let n be the number of elements of battery or accumulator required, each having an electro-motive force e, and an internal resistance r; the greatest possible intensity of current to be obtained from each will be, from Ohm's law,

$$i = \frac{e}{r} \qquad (2)$$

that is, when short circuited, but no useful work is done. The maximum of useful work is obtained when the external resistance is equal to the internal, or when

$$i = \frac{e}{2r} \qquad (3)$$

In practice, however, it is found more economical to make the external resistance four or five times that of the battery, to decrease the effects of polarization, and increase the *efficiency*, or proportion between the useful work and the energy expended. The practical value of i must therefore be determined by the nature of the element, its size, the length of time it is required to work, etc.

As each element or series of elements should only be traversed by a current i, q, the number of series should be such, that

$$qi = I \qquad (4)$$

$$\text{from which } q = \frac{I}{i} \qquad (5)$$

If t be the number of elements in each series, the value of I, according to Ohm's law, is

$$I = \frac{te}{\frac{tr}{q} + \frac{r'}{n'}} \qquad (6)$$

$$\text{from which } t = \frac{qe'}{qe - rI} \qquad (7)$$

If the resistance R of the connecting wires is large enough to be taken into account and all the lamps are in one group, formula (6) becomes

$$I = n'i' = \frac{te}{\frac{tr}{q} + \frac{r'}{n'} + R} \qquad (8)$$

The value of q is the same, but t becomes larger. When the lamps are in different groups, the formula is a little more complicated.

For example, let there be 50 Swan lamps, whose constants are $i' = 1.5$ ampères, $e' = 48$ volts, r' taken hot, 32 ohms. How many Faure accumulators will be required to supply them? The constants of each element are, for a current i of 16 ampères, $r = .01$ ohm, $e = 2$ volts. The resistance of the connecting wires is supposed to be zero.

From (1), $I = n'i' = 50 \times 1.5 = 75$ ampères.

From (5), $q = \frac{I}{i} = \frac{75}{16} = 4.68$; as q must be a whole number, $q = 5$.

From (7), $t = \frac{qe'}{qe - rI} = \frac{5 \times 48}{(5 \times 2) - (.01 \times 75)} = 25.8$; $t = 26$.

Therefore, 5 series of 26 elements each, or a battery of 130 elements, will be required.

We have given i a value of 15 ampères only, in order that the polarization may not bring the electro-motive force below 2 volts. Let us suppose that the cells can be worked to their full capacity, that is, make

$$i = \frac{e}{2r} = \frac{2}{2 \times .01} = 100 \text{ ampères.}$$

As the lamps require only 75, $q = 1$, and t becomes

$$\frac{qe'}{qe - rI} = \frac{1 \times 48}{2 - (.01 \times 75)} = 38.4$$

39 elements arranged in 1 series will suffice.

A voltaic cell or accumulator may be regarded as a reservoir containing a certain quantity of electricity, but the amount available for useful work is much less than this. If we represent by Q (expressed in coulombs) the quantity thus available, the number of seconds S, during which normal working will continue, will be

$$S = \frac{Q}{i} \qquad (9)$$

since a current of i ampères equals i coulombs per second. It has been found that a Faure accumulator weighing 5 kilogrammes, will furnish 500,000 coulombs. Applying formula (9) to the first solution of the example, where $i = 15$

$$S = \frac{Q}{i} = \frac{500,000}{15} = 33,330 \text{ seconds} = 9 \text{ hours } 15 \text{ minutes.}$$

In the second solution, provided each accumulator could furnish 500,000 coulombs before e falls below 2 volts,

$$S = \frac{500,000}{75} = 6,660 \text{ seconds} = 1 \text{ hour } 51 \text{ minutes.}$$

A comparison of the length of normal working in each case with the number of accumulators, shows a decided advantage in favor of the smaller value of i, although the total energy given out by each cell is the same in both cases. The resistance of the 50 lamps is .64 ohm; of the 130 cells, .05 ohm; of the 39 cells, .39 ohm. In the first case work has to be done against .69 ohm resistance; in the second, against 1.03 ohms. Therefore, to give the current a strength of 75 ampères, an electro-motive force of 52 volts will suffice for the smaller resistance, while 78 volts are necessary for the larger.

FRED. W. STONE.

THE ELECTRO-CHRONOMETRIC INDICATOR,

OF MR. THOMAS, OF BRUSSELS.

THE problem of electric horology is one so complicated and delicate, that, although a great number of solutions of it have been proposed, it is impossible to say which is the most perfect or even most practical.

It was shown by numerous examples, presented during the Paris Electrical Exhibition, that, in electro-horology the current serves three distinct purposes, as follows:

1. The electricity may serve, instead of the customary spring or weight, as motive power for a clock pendulum. In this case its application presents the least interest or utility, although in one or two instances the electric current is so ingeniously applied that the pendulum will swing for two years without being touched.

2. The electric current serves for the transmission of time. In this case a central clock momentarily closes a circuit at every second, half-minute, or minute of time, and transmits an electric impulse to one or several dials, distantly located, the hands upon which advance a second, half-minute or minute, respectively. Such apparatuses are called *Electro-chronometric Indicators*[1].

3. The electric current is employed to regulate a number of ordinary clocks, or dials, actuated by the usual weights or springs, and every one, six, or twenty-four hours, it places the hands of all the dials in a circuit in synchronism with the hands of a central regulator, and thus corrects the slight inaccuracies they may develop between two succeeding regulations.

This is the system of periodical regulation adopted by the city of Paris for its public clocks.

Although we do not propose to discuss herein the advantages or inconveniences of these two systems, the former system of distributing time in a city, by chronometric indicators, has some special advantages, which cannot be claimed

1 A system of this description is in use at the Cooper Union, N. Y.

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for the latter. The pneumatic clocks, which have been successfully operated in Paris for more than two years, are "compressed-air chronometric indicators." An effect which can be obtained pneumatically should be easy to obtain electrically, and at an unlimited distance from a single operating station.

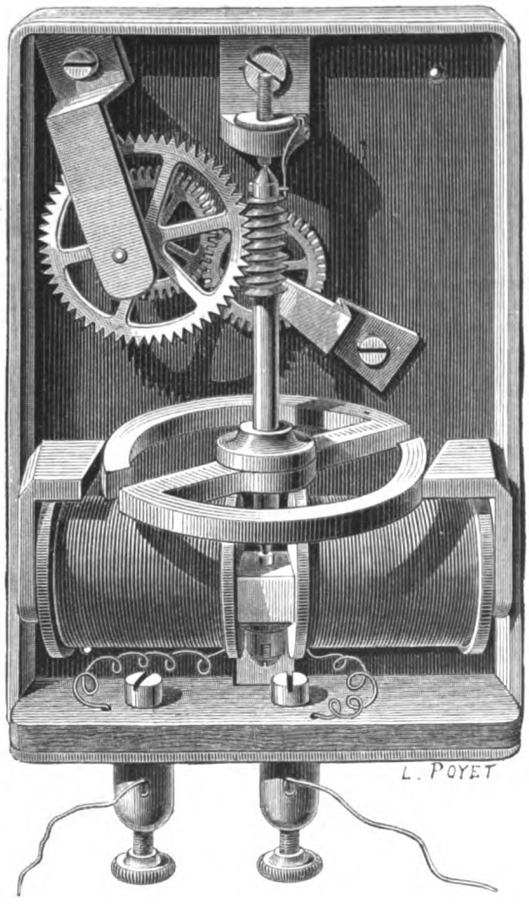
We wish now to describe a chronometric indicator of great simplicity, which accurately attains the purposed end, that is to say, it operates *surely* at the desired moment, under the influence of electric impulses transmitted by the central distributing regulator.

All chronometric indicators, so far devised, are actuated by the operation of an oscillating armature, solicited by an electro-magnet and restored by an antagonistic spring; or else by the electro-magnets acting on a polarized armature.

The movement of the armature is transmitted with extreme accuracy by levers or catches, adjusted with most careful delicacy, and which cease properly to act as soon as they obtain a little play by wear or oxidation.

In order to utilize a very limited motion of the armature it is necessary, therefore, to elongate the levers beyond measure, and chronometric indicators of this system do not accommodate themselves to the tremor, to which in many buildings they must be subjected.

All of these inconveniencies are avoided in the mechanism of the Thomas indicator, which is represented in the subjoined cut.



It consists of a straight electro-magnet, the poles of which are prolonged at right angles to the core by two armatures, which clear the spool, and are again bent at right angles toward each other, close to the spool and parallel with the core. Between them there is left a space wherein a permanent magnet, in the form of an S, is supported upon a vertical axis.

This axle carries an endless screw which engages with the train of wheels that drives the hands. Every half-minute a current is sent through the electro-magnet by the regulator, first in one direction and then the other, alternately. The direction of the current is so determined, that, each time it develops in each armature of the electro-magnet a polarity of the same kind as that opposed to it by the contiguous pole of the S magnet. The nearest or like poles of the S magnet are, therefore, repelled, and the most remote or opposite poles attracted, whereby a half revolution of the S magnet is determined, which brings the unlike poles of the two magnets in juxta-position. The current is permitted a duration of two or three seconds, in order that the S magnet may attain its position. When the electric current ceases, the influence of the S magnet causes the electro-magnet to maintain, temporarily, the polarity it had acquired, and to act as a magnetic break, which holds the S armature in position.

The transit of the succeeding current in the reverse direction inverts the polarization of the electro-magnet, and causes the S magnet to complete its revolution, and so on. The endless screw engaged with the train of wheels carries the hands forward at each movement.

In virtue of its inertia, the S magnet tends to fly past the position of equilibrium. To obviate this inconvenience, the velocity it has acquired towards the end of each half turn is retarded by a pin inserted in the axle of the endless screw, which rubs against a flexible strip of metal depending from the frame above.

This simple and ingenious apparatus requires no further regulation. The rotation is produced, whatever may be the distance between the extremities of the S armature magnet and the electro-magnet, and this distance can vary between one and three-twentieths of an inch.

The electric force acts (through the electro-magnet) upon the long arm of a lever, (the S magnet) while the effect is transmitted by the short arm of the lever, (the endless screw) which is the inverse of other gearing.

The power of the apparatus may be graduated by the dimensions of the S magnet, and of the electro-magnet, and by the size and length of the wire which surrounds the soft iron core. By augmenting the intensity of the battery employed, a great number of clocks may be included in one circuit, and dials of six feet in diameter may be associated in circuit with the smallest clocks.

At the Brussels exhibition, where the chronometric indicator of Mr. Thomas was first shown in operation, the same circuit included a great dial 4½ feet in diameter, and 18 smaller dials from 1 foot to 14 inches across.

They all operated steadily, except upon five or six occasions, when the controlling regulator was temporarily stopped, but all who visited the Brussels exhibition are aware that the floor vibrated so, that the other clocks were constantly stopping.

Knowing that a hand indicating the minutes amply suffices for the use of the public, that the emission of the current continues only three seconds, that is to say, one twentieth of the total time, and that the electric energy expended by the indicator is extremely feeble, we ask, "what is to prevent the economical distribution of time by electricity?"

By taking advantage of the $\frac{19}{20}$ of the time, during which no electricity is expended, to charge accumulators at the central station, an establishment provided with a gas engine of four horse power would produce enough electricity to actuate 25,000 electro-chronometric indicators, in a district having a radius of 20 kilometres (12 miles).

What other systems are there, that to-day, can do as much? —*L'Electricien.*

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TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

A VOLTAIC current sent through a conductor causes, by induction, it is well known, a contrary current in a closed parallel circuit that is near. On removal of the inducing current, there is generated in the same circuit a current of direction opposite to that of the first. If the resistance of the induced circuit be considerable, the two currents thus generated have the character of electricity of tension, and may reproduce the effects of ordinary electrical machines. This is the theory of the Rhumkorff coil.

Such being the case, it was natural to inquire if the system were not reversible; if, in other words, on sending through the fine wire of a coil the discharge of an ordinary electric machine, there would not be generated in the thick wire an induced current of very small tension, and similar to voltaic currents.

It was in 1875 that Bichat made his first experiments in this relation. He was able, with a Holtz machine and a Rhumkorff coil, to decompose water and to deflect permanently the needles of a galvanometer. He stopped there, either failing to see all the importance of his discovery, or drawn to other work which seemed more pressing.

For the experiment just described to succeed, the electric discharges must be pretty strong. Without this condition (which is easily realized with condensers), the effects of the induced current are too weak to be easily observed. Another condition to be attended to is not to allow much interval between the inducing currents, destroying the quasi-continuity (a point of similarity to the voltaic current).

This induced current has indeed a character by which it is easily distinguished. Instead of being really one and continuous, it is double and dis-continuous. When the spark passes, an induced current is generated in one direction, and immediately after passsage of the spark, there is another current of opposite direction. But the rapidity of the electric discharge is such that practically these two currents seem to make but one. Another cause of discontinuity is the discontinuity of the inductive sparks themselves. Apart from these features, the generated current behaves quite like the currents produced by batteries with liquids.

Its tension is very small, and then it does not give a spark even with the least interruption of the circuit. On passing the current through the acidulated water of a voltameter, decomposition occurs, and under each test-tube a certain quantity of gas collects. As the current is continually reversed, the gas is a mixture of oxygen and hydrogen, the proportions of which vary in each experiment. By regulating suitably the resistance in the induced circuit, a means may be found (it is thought) of eliminating one of these two currents, and so of separating the gases one from the other.

On putting a galvanometer in the circuit, the needle is not sensibly deflected, so long as the circuit does not present a special resistance; but if an interrupter be introduced (a Froment vibrating reed, e.g.) the needle is suddenly and permanently deflected, and this deflection is so considerable as to inspire the hope of being able to utilize the induced current.

If one of the rheophores be connected with a file, and the other drawn over the rough surface of the file, one obtains a track of reddish light like that produced on repeating the experiment with a voltaic battery. This phenomenon is not that of the spark; it is due to particles of iron and carbon, which, under action of the current, are detached from the line, fused or volatilized, and forming a sort of bridge between the asperities over which the reophore is drawn.

If the two reophores, each terminated by a very fine point of carbon, prepared for the voltaic arc, be brought into contact and then separated, one immediately sees a jet of electric light, similar to that furnished by the Gramme machines and batteries. On repeating these experiments with a conducting wire and a bath of mercury, a luminous arc is obtained, due to incandescence of mercury vapors; this arc is less brilliant, but more durable.

The induced currents circulating round a cylinder of soft iron produce in it rapid magnetizations in two opposite senses, as may be demonstrated, either by the magnetic spectra obtained with iron filings, or by the vibrations of a very mobile and very light slip.

Lastly—and this experiment is the most curious of all—the induced current generated in a Rhumkorff coil by the electric discharges may be sent into a second coil like a battery current, and will produce in that long sparks, with which all the phenomena of the Rhumkorff coil may be repeated.

These, then, are the chief results obtained in transformation of static electricity into dynamic currents. What may the future of this discovery be? If, with the small Holtz machine, which served as exciter of the current in these experiments, Prof. Govi was enabled to decompose water, redden a bad conductor, and produce the voltaic arc, we need not despair (says M. Battandier in *Les Mondes*) of obtaining powerful currents with improved apparatus, and that with a less expenditure of force. "We may even, perhaps, by multiplying or better insulating the discharges of atmospheric electricity, become master of this fluid, so capricious and menacing, and turn it to domestic use."—*Ex.*

TELEGRAPHY IN JAPAN.

THE Japanese telegraph net, which was commenced in 1871, embraced, at the beginning of last year, 3,929 miles of road and 9,345 miles of wire. The total number of telegrams forwarded during the year, amounted to 1,272,756, of which 96 per cent. were written in the Japanese tongue. Japanese having no alphabet of individual letters, it has been necessary, for telegraphic purposes, to make up combinations of Morse characters, representing the sounds of each of the syllables contained in the so-called Katakana. For this purpose letters of the international code have been used, and been supplemented by others made up of fine dots and strokes, which represent a total of 47 signs, minus the figures. The alphabet that had been formed in that way answered well enough for about eight years. From a school of telegraphy for the instruction of young Japanese, some 227 regular and assistant telegraph officials have been drafted, and there are now 97 students left in that institution. They are taught to speak and write English and French, and they generally receive a primary education similar to that given in England. The average charge for conveyance of twenty Japanese characters, at a distance of 60 miles, is three *sen*, or rather less than a penny. On the line from Tokio to Yokohama, the transmission takes place for seven *sen*, or about 2½*d.*, to a distance of 20 miles. In 1880 there were open to the public 112 offices; besides these there were 70 in connection with the various departments of the State, the railways, and the police stations. There are now in use, 343 Morse apparatus, 26 Block instruments with one needle, and 29 telephones on the Bell system. In the school of telegraphy there are 71 instruments of various descriptions for practising purposes; and, in the Straits of Shimonoski, five cables have been laid.

—— THE ELECTRIC STORM on the twenty-fourth of November, was very severe in Boston. In several places, No. 14 copper, and No. 12 iron, wires were melted. Several of the American Union messenger call boxes were burned. Three fire alarm boxes of the Automatic Signal Telegraph Company, and one of the annunciators of the Police Department had their connections melted. It is stated that there is no place where a connection with electric lighting wires was possible. All the telegraph lines were operated with diminished battery power, and it is claimed that some messages were sent without the use of any battery. In electric lighting, this phenomenon produced similar results. Each of the circuits of the Weston Electric Company, at their stations on Eastern Avenue and Stanhope Street, Boston, are run by four dynamo machines in series; but during the electrical storm three dynamos in series were ample to produce the number of lights, which at all other times have required four machines. The two lighting stations referred to, are about three miles distant from each other, and a number of circuits, comprising some three hundred arc lights, were operated in this manner.

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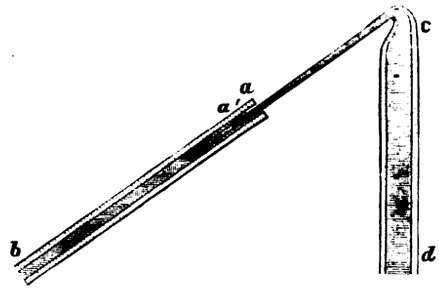
AN ILLUSION—EXCEPTION TO REGULARITY OF SIPHON.

PERPETUAL motion has been the *ignus fatui* of many inventions, and a great many people to-day believe in the possibility of an impossibility being obtained. The fact would, however, at first sight seem to be obtained by the little apparatus shown in cut. Take a cylindrical capsule and pour into it distilled water to the depth of one centimetre ($\frac{1}{3}$ of an inch): put into this water one of the ends of a small glass tube .050 of an inch in diameter and about 2½ or 3 inches long. Keep the tube in a suitably inclined position, so that the water that rises through capilliary attraction, will occupy a sufficient portion of its length. Then take a second tube having about $\frac{1}{10}$ of an inch in diameter, and about 1½ inches in length. Thin down this second tube at one end, and turn back the part thus obtained so as to make an acute angle with the wide portion. Introduce the thinner portion into the upper orifice of the inclined tube until it reaches the water contained therein, and a vertical descending position to the wide portion. This can be done, either by modifying the above angle, or by the inclination of the other tube. Let us suppose, that the orifice in the vertical portion does not reach the liquid in the capsule, and that the thin part and the vertical tube are both full of water. The figure which gives a section of the top will show this more plainly.



A, *b*, is the inclined tube, and *c*, *d*, is the vertical tube. On account of the small width of the space comprised between the thin portion and the interior of the tube *a*, *b*, the capillary attraction will maintain the water near the orifice *a*, of the latter. Let us suppose that it stops at *a'*. The lower end of the tube *c*, *d*, not reaching to the liquid in the capsule, this latter tube with its narrow portion will form a siphon, the shorter branch of which will be plunged in a liquid in equilibrium, and the longer one descending more than an inch below the surface of this liquid. It should appear then as if the water should continually pass out of the siphon to join the water in the capsule, and we would thus have perpetual motion.

Knowing the impossibility of this, we tried to ascertain what would really take place in such conditions.

Instead of flowing out by the tube *c*, *d*, the water ascends in it, on the contrary, and continues to be drawn up until its surface reaches a certain part of the narrow part, after which everything stops. In order that the water be drawn up, however, the orifice of the tube *c*, *d*, must be several millimetres above the liquid in the capsule. If it is lower, the tube *c*, *d*, remains full and the water suspended.

A little reflection will show the reason for what at first sight seems singular. The small surface that ends the liquid at *a*, between the two tubes, is concave transversely. By reason of this curvature it causes a suction over the liquid mass to which it belongs, that is to say, on the liquid in the tube *a*, *b*, and in that in *c*, *d*, this last communicating with the first by the narrow tube. In the tube *a*, *b*, this suction has the effect of keeping the water up to *a*, and is equipoised by the action of weight—an action that is measured by the difference in level between the small surface at *a*, and the water in the capsule. It would at first seem requsite that to have it equipoised in the tube *c*, *d*, that the difference in level between the small surface at *a*, and the orifice of this tube *c*, *d*, should be equal to the preceding, which would require that the orifice should reach the water in the capsule. But we see that the equilibrium is maintained even when the orifice is several millimetres higher. In this case the water, from its tendency to absorption, presents a slightly concave surface to the orifice, and this having a slight suction from above to below, and which combines with the effect of the weight, the suction coming from *a* is compensated. For a greater distance than that from the orifice to the water in the capsule, the suction at *a* is in excess, the liquid is drawn from below to above in the tube *c*, *d*, and the movement stops when the free surface of the liquid has reached the narrow part at a point where the suction, due to the strong concave form, equiposes that at *a*. It shows a curious instance of the action of concave liquid surfaces, and an exception to the regular working of the siphon.—*La Nature.*

SPARKS.

—— THE FIRST VOLUME of a new work on electricity, by Herr G. Wiedemann, has appeared. It is entitled "Die Lehre von der Electricität."

—— MESSRS. PIETTE AND KRIZIK, the inventors of the Pilsen lamp, have been driving a threshing machine by electricity at an agricultural show in Lundenburg.

—— THE ELECTRIC LIGHT, (Weston) used at the headings of the Hudson River Tunnel has caused the grain spilled from the mule's rations to germinate.

—— ON DECEMBER 1, Annie Stadhneyer was found in an unconscious condition at No. 47 Bowery, the gas was escaping from a burner in the room when the door was opened.

—— ON DEC. 19TH, a fire occurred in the large store of I. P. Lovell & Sons, of Boston; it was caused by an explosion of gas in the basement, two persons were badly injured, and the loss was $135,000.

—— THE *Telegram* recently published a list of some fifty persons in this city and twenty-five out of the city, who met death by inhaling gas through accident or design, within the last twenty-three months.

—— ON DECEMBER 5, an explosion, caused by escaping gas, in the basement of the four-story brick building on the South-west corner of Grand and Chrystie Streets, resulted in a loss by fire and water of $25,000.

—— M. GEOFFROY, a wire manufacturer in Paris, has taken a patent for covering electric wires with asbestos. Experiments, which will be repeated officially, have proved that the copper can be burnt without any spark being conducted outside.

—— LECTURING RECENTLY at Edinburgh, Professor Fleeming Jenkin said the popular mind supposed that electricity would supersede steam; but what had taken place, was, that engines were employed to produce electricity, and electricity afforded us the best means yet discovered for distributing power.

—— ON THE EVENING of Dec. 14th, Mr. John E. Pendleton gave a lecture in Boston, "On Storage of Electricity," before the Society of Arts, which was illustrated by numerous and brilliant experiments. Prof. Cross stated that it was the first public lecture ever given in which the storage battery was used.

—— DURING SOME RECENT trials, at London, of Kelway's electric log on board the steam-tug *Pixie*, a number of runs gave a mean of 7·2724 knots, while the same distance, by actual measurement, was 7·2768; the difference is thus, 0·0044, which is probably the nearest approach to accuracy obtained by any log.

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—— THERE ARE ABOUT eight hundred arc lights in Boston, of which one hundred and sixteen are used for lighting streets and squares. At a public hearing before the Board of Aldermen some time ago, one of the Police Commissioners testified that one electric light was equal to five policemen in some parts of the city.

—— A PAMPHLET, describing the formation and use of M. de Kabath's electric accumulators, has been issued in English, and is supplied by Messrs. Dawson & Sons. We recently described the accumulator, which is said to offer fifteen times the surface for the same weight as the Planté. This result is obtained by the use of thin plates of corrugated lead.

—— THE VOLTA PRIZE of 50,000 francs, offered by the French Government in 1887 will be awarded to the author of the discovery which shall be adjudged to have best increased the facility of applying electricity as a source of light, heat, power, chemical action, or as a transmitter of messages; or in the treatment of disease. June 30, 1887, is the last day for receiving claims, and the prize is open to the savants of all nations.

—— THE VARIOUS OFFICES, the engine-room, and part of the works of the Amsterdam Gas Company are illuminated by Maxim incandescent lamps, the dynamo being driven by a gas engine. A battery of 36 Planté accumulators is interposed between the machine and the lamps, for the purpose of obtaining steadiness; and it is found that it is capable of supplying the current required during the night when the engine is stopped.

—— PROF. FLEEMING JENKIN has patented an electrical system of transporting goods, which he calls "Telpherage." It resembles the wire-rope system, in so far that the vehicles are supported on strained conductors, which suspend the load and at the same time convey the electric energy. There can be no collisions, as if one train gets on to a section occupied by another, it is deprived of motive power and brought to a standstill until the section is clear.

—— THE CORRECT TIME of the meridian of the State House at Boston may be obtained from Harvard College Observatory at any Western Union telegraph office by paying the price of a ten-word message from Boston. The signal consists of a tap upon the telegraph instrument every other second, and the beginning of a minute is noted by the omission of the tap upon the fifty-eight second of each minute; and twelve taps are omitted before the commencement of each five minutes.

—— AT A RECENT meeting of the Academy of Sciences, in Paris, a paper was read by M. Mascart, on the electrification of air. In the Amphitheatre of the College of France, he electrified the air by discharging a Leyden jar with a flame, during ten seconds; another flame, 8 m off, communicated with an electrometer in an adjoining hall. The maximum deflection in the latter was reached in about a quarter of an hour; then there was slow diminution, but after two hours 1-20th of the maximum still remained. The electrified gas probably rises and is diffused like smoke. To study the lower atmospheric layers, the potential should be determined in a large inclosure formed of metallic netting, connected with the ground.

—— IT IS SAID THAT a demand for persons having a knowledge of electricity and mechanical construction is being caused by the various electric light companies abroad. The Anglo-Austrian Brush Company advertise that they register applications for employment on their staff on works abroad, such as those who have had practical experience in the designing, manufacture, or installation of dynamos, arc, or incandescent lamps, accumulators, telephones, telegraphs, and other electrical apparatus, or as mechanical draughtsmen in engineers' shops, or as engineers in the construction and erection of steam engines, water or gas works.

—— IN THE LAST SITTING of the Syndicat d'Électricité, of Paris, M. Jablochkoff described a new element which he has invented, and which consists of sodium for the electro-positive plate, the negative being, as usual, carbon. M. Jablochkoff does not use any exciting liquid, but merely sends into his elements, by the instrumentality of an aspirator, a current of air saturated with moisture. He says that soda is dissolved and falls to the bottom of the box where his elements are kept so that it may be easily collected and sold at a high price, being pure except for a small quantity of carbonate and of nitrate. According to his statement the electro-motive force of this element is about 4 volts.

—— THE LAST ACCIDENT from the electric lighting apparatus is that of a severely sprained wrist, which was caused in this manner: A man with a dust pan in his hand was passing a dynamo machine, when the magnetism attracted the dust pan so suddenly, that the man's wrist was so severely wrenched that he was disabled for some time.

—— AT A recent meeting of the Physical Society, London, Prof. S. P. Thompson stated that in the *Journal de Paris* for 1802, there is a note describing the voltaic arc between carbon points, as produced by M. Etienne Gaspar Robertson, at Paris, in that year. Laboratory note books, at the Royal Institution, indicate that Sir Humphrey Davy experimented with the arc quite as early. Prof. Thompson also exhibited a telephone made by Reis, at Frankfort, in 1861, expressly designed for transmitting speech.

—— THE MAGNETISM in the field magnets of dynamo machines is so powerful that it will attract particles of iron or steel a long distance. They should not be placed anywhere near grinding machinery. A very large dynamo was ruined by attracting particles of iron from emery wheels, thirty feet away, and separated by a partition through which were numerous belt holes. The iron dust accumulated upon the holes of the magnets, and wore the insulation from the wires of the armature revolving in front of them.

—— ONE RESULT of the Munich Electrical Exhibition, has been the formation of a (so called) Consortium or company, with a view to promoting the application of electricity to practical requirements. It is presided over by Herr v. Maffei. In the first place, where the introduction of electro-technical methods is regarded as possible, the company will offer a helping hand, either by directly undertaking to work out the problem proposed, or by initiative inquiry into the utilization of coal beds, water power, etc., for electro-technical purposes. Next, assuming necessary help to be given by the State, by cities, socicties, and scientific corporations, it is proposed to found an *Electro-Technical Experimental Station for Bavaria*, the object of which will be to give authorities and private persons, contemplating electro-technical arrangements, opportunity of informing themselves as to the questions involved, and different systems, on the basis of impartial experiments, and of obtaining a satisfactory idea as to cost and feasibility of arrangements proposed. Opportunity will also be given for testing new machines and apparatus.

BUSINESS NOTICES.

THE subjoined letter being one of a number most kindly sent us recently, we publish with much satisfaction, and have no doubt it will interest our patrons:

HARTFORD, Conn., Dec. 12, 1882.

Williams & Co., 115 *Nassau St., N. Y.:*

GENTLEMEN—Wishing to express my esteem for your paper, would say that from the three insertions of my advertisement I have received over 200 replies, some of them having already ordered, who state they saw advertisement in the ELECTRICIAN, and do not doubt that others came from the same source.

By all means keep my space for me.

Yours truly, A. H. EDDY.

MESSRS. BURKE, FRASER AND CONNETT'S "Quarterly Circular of Information and Advice about Patents on Inventions, published for the free use of their clients," for December, is particularly interesting, containing valuable articles on "A Few Mechanical Movements, Patents in France, A Warning to Inventors, The Duration of United States Patents, The United States Patent Law," etc., etc.

WANTED—RESPONSIBLE POSITION, by an Electric Light Engineer, of several years' experience in arc and incandescent lighting with two of the largest companies in America and Europe. Good Mathematician and Mechanical Engineer; accustomed to calculate Dynamos, etc.; acquainted with the manufacture of all kinds of electrical light apparatus. Address "Enquirer," office of ELECTRICIAN, room 55, 115 Nassau St., New York.

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PATENTS FOR NOVEMBER AND DECEMBER, 1882.

NOVEMBER 21st.

267,807 Annunciator, Electrical. F. Tanner, Detroit, Mich.
267,987 Burglar Alarm, Electrical. C. A. E. Ruebel, Chillicothe, Ohio.
267,859 Electric Machine Regulator, Dynamo. J. R. Finney, Pittsburg, Pa.
267,945 Electric Signaling Apparatus. H. W. Southworth, Springfield, Mass.
267,711 Electrical Apparatus, Commutator for. C. C. Peck and W. H. Chapman, Middleburg, Vt.
267,747 Electrical Switch Board. J. F. Gilliland, Indianapolis, Ind.
267,691 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
267,710 Pumping Apparatus, Electric. C. C. Peck, and W. H. Chapman, Middleburg, Vt.
267,978 Railway Signal Apparatus, Electric. O. Gassett, Boston, Mass.
267,979 Railway Signal Apparatus, Electric. O. Gassett, Boston, Mass.
267,860 Secondary Battery. J. R. Finney, Pittsburg, Pa.
267,804 Secondary Battery. E. F. Starr, Philadelphia, Pa.
267,878 Telegraph Key. J. T. Guthrie, Leesburg, Ohio.
267,883 Telegraph Line, Underground. C. H. Hansen, Washington, D. C.
267,833 Telegraph Sounder. J. H. Bunnell, New York, N. Y.
267,929 Telegraphic Register. E. L. Pope, Elizabeth, N. J.
267,905 Telephone Exchange, and Apparatus therefor. H. Lartigue, Paris, France.
267,897 Telephone, Mechanical. H. T. Johnson Scio, N. Y.
267,790 Telephone System. W. A. Jackson and W. R. Cole, Detroit, Mich.

NOVEMBER 28th.

268,060 Electric Cable. R. S. Waring, Pittsburg, Pa.
268,157 Electric Cable. R. S. Waring, Pittsburg, Pa.
268,158 Electric Cable, Lead Armored. R. S. Waring, Pittsburg, Pa.
268,039 Electric Cable, Submarine. R. S. Waring, Pittsburg, Pa.
268,324 Electric Cables, Dividing and Branching. R. S. Waring, Pittsburg, Pa.
268,159 Electric Cables, Uniting and Branching. R. S. Waring, Pittsburg, Pa.
268,174 Electric Generator. V. W. Blanchard, New York, N. Y.
268,255 Electric Machine, Dynamo. R. H. Mather, Windsor, Conn.
268,331 Electric Machine, Dynamo. E. Weston, Newark, N. J.
268,205 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J.
268,175 Electric Storage Batteries, Apparatus for Charging. V. W. Blanchard, New York, N. Y.
268,031 Electric Wire Conduits, Increasing and Reducing Joint for. C. Linford, Pittsburg, Pa.
268,316 Electrode, Vaginal. A. W. Tipton, Jacksonville, Ill.
268,218 Lamp, Electric-arc. A. Graham, London, England.
268,224 Lamp, Electric-arc. E. J. Harling, and E. Hartmann, London, England.
268,038 Lamp, Electric-arc. J. McLaughlin, Chicago, Ill.
268,254 Lamp, Electric-arc. R. H. Mather, Windsor, Conn.
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268,269 Lamp, Electric Incandescent. J. V. Nichols, Brooklyn, N. Y.
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268,329 Lamp Holder, Incandescent. E. Weston, Newark, N. J.
268,330 Lamp Holder, Incandescing-electric. E. Weston, Newark, N. J.
268,206 Lamp, Incandescing-electric. T. A. Edison, Menlo Park, N. J.
268,099 Magneto-electric Machine. O. Heikel, Jersey City, N. J.
268,360 Secondary Battery. A. K. Eaton, Brooklyn, N. Y.
268,303 Secondary Battery. E. T. and E. E. Starr, Philadelphia, Pa.
268,237 Telegraph Printing. A. F. and F. B. Johnson, Brooklyn, N. Y.
268,317 Telegraphic Circuits, Condenser for. B. Thompson, Buffalo, N. Y.
268,294 Telephone Exchange System and Apparatus. J. H. Rogers, New York, N. Y.
268,045 Telephone Toll Apparatus. J. W. See, Hamilton, Ohio.
268,359 Telephonic Apparatus. W. J. Dudley, Boston, Mass.
268,034 Insulating Compounds, Manufacture of. M. Mackay, London, England.
268,075 Insulator, Noise Deadening. G. M. Brown, Woonsocket, R. I.

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268,389 Electric Wires, Carrying and Conducting. W. M. Conway, Baltimore, Md.
268,392 Lamp, Electric-arc. N. H. Edgerton, Philadelphia, Pa.
268,394 Lamp, Electric-arc. J. R. Finney, Pittsburg, Pa.
268,476 Railways, Traveling Contact for Electric. J. R. Finney, Pittsburg, Pa.
268,661 Telegraph, Underground. L. Haas, Chester, Pa.
268,478 Telegraph Wire. F. K. Fitch, New York, N. Y.
268,561 Telegraphic Repeater. J. P. Smithers, Brooklyn, N. Y.
268,746 Telephone, Acoustic. J. K. Stebbins, Ashtabula, Ohio.
268,554 Telephone, Head. F. Shaw, New York, N. Y.
268,630 Telephone, Receiving. G. F. Dailey, Leadville, Col.
268,523 Valves of Steam Engines, Electric Device for Operating the Throttle. J. Nesbitt, Toronto, Ontario, Canada.

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268,956 Electric Machine, Dynamo. E. A. Sperry, Cortland, N. Y.
268,980 Electric Machines, Armature for Dynamo. F. Bain, Union City, Ind.
269,036 Electric Machines, Armature for Dynamo. A. B. Fisher, Union City, Ind.
269,082 Electric Motor, for Geissler Tubes. W. J. McCollous, Aurora, Ill.
269,085 Electrical Conductors, Conduit for. J. K. McLaughlin, Philadelphia, Pa.
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269,092 Electrical Locomotive. E. J. Molera, San Francisco, Cal.
269,132 Lamp, Electric. W. Stanley, Jr., Englewood, N. J.
269,80 Lamp, Electric-arc. C. M. Ball, Troy, N. Y.
269,151 Lamp, Electric-arc. L. G. Wooley, Mendon, Mich.
268,851 Lamp, Carbon Holder, Electric. C. M. Ball, Troy, N. Y.
269,013 Lamps, Cut-out for Electric. C. F. Coleman, and H. A. Smith, Atlanta, Ga.
268,796 Telegraph for Railways. W. L. Hunt, Port Hope, Ontario, Canada.
269,124 Telegraph Signal Box, Automatic. P. Seiler, San Francisco, Cal.
269,150 Telephone, Exchange, Automatic. F. H. Snell, Washington, D. C.
269,030 Telephone, Mechanical. C. Egan, Zanesville, Ohio.

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269,476 Electric Circuits, System for Utilizing Time Switches for. E. T. Starr, Philadelphia, Pa.
269,379 Electric Wires, Conduit for. B. Boyer, Lebanon, Pa.
269,328 Electrical Connecting Cord. W. H. Sawyer, Providence, R. I.
269,281 Electricity, Transmission of Power by. Z. T. Gramme, Paris, France.
269,331 Electro-magnetic Engine. A. E. Schreiber, Brooklyn, N. Y.
269,318 Electro-magnetic Motor. C. C. Peck, and W. H. Chapman, Middlebury, Vt.
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269,239 Incandescents, Treating. M. M. M. Slattery, New York, N. Y.
269,417 Lamp, Electric-arc. A. G. Holcombe, Danielsonville.
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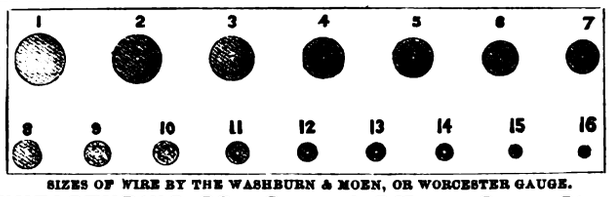

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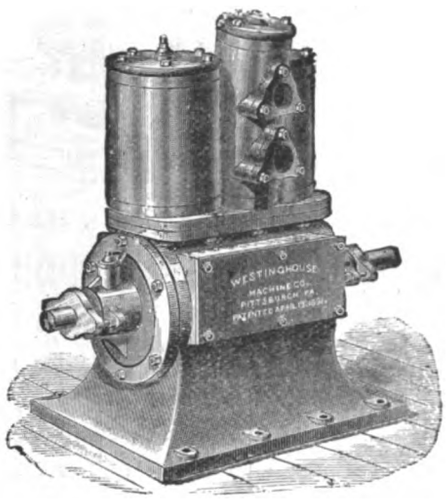

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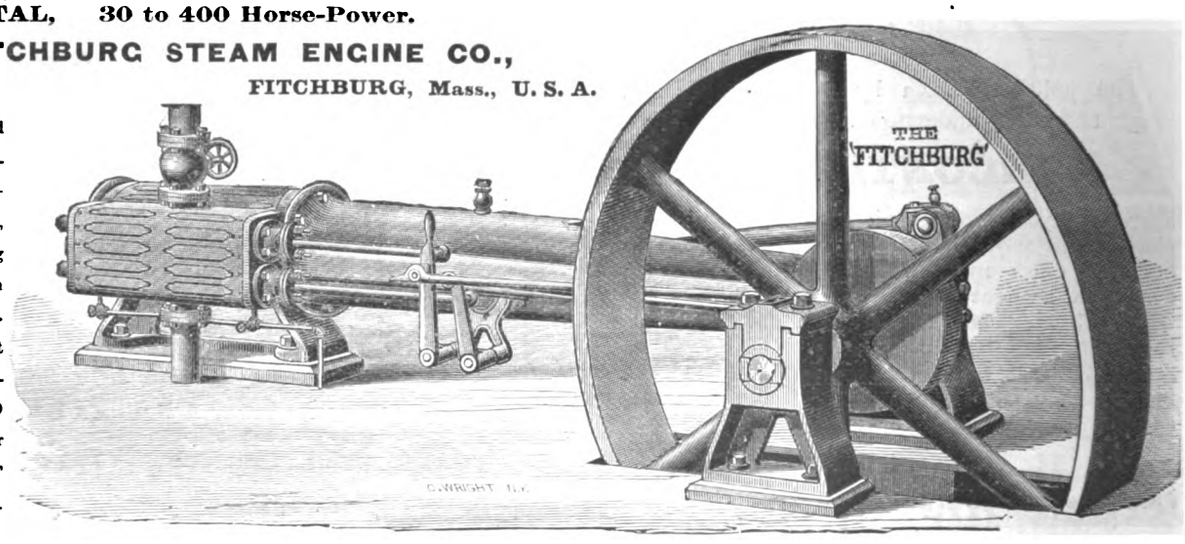

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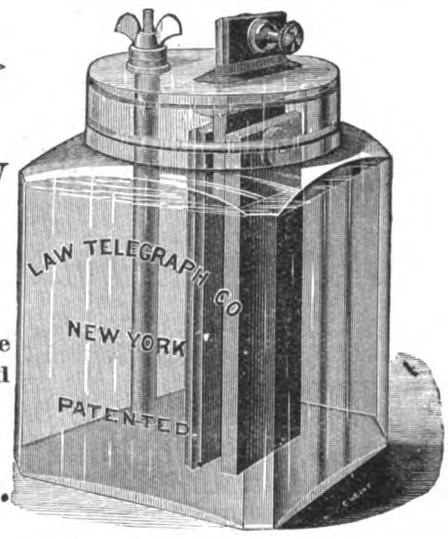

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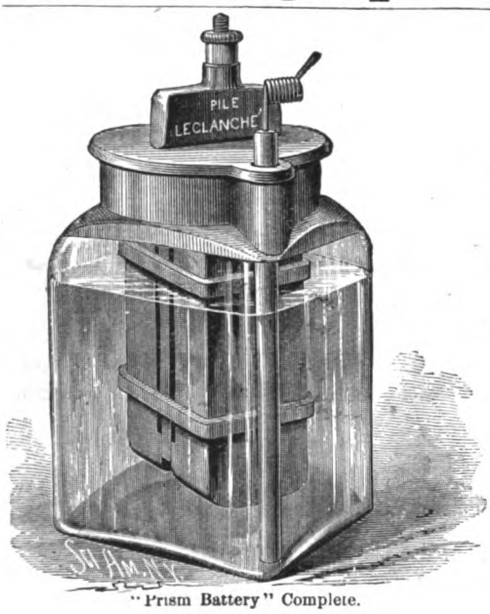

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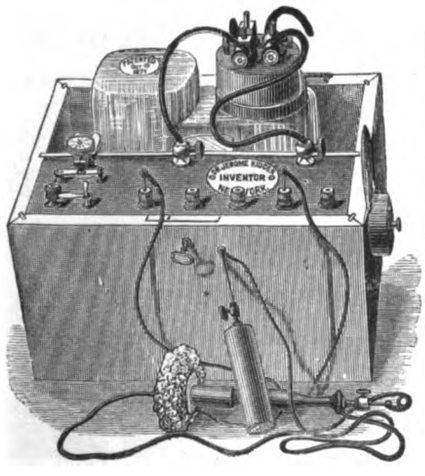

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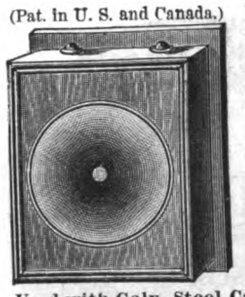

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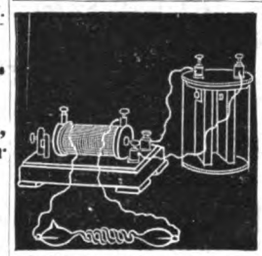
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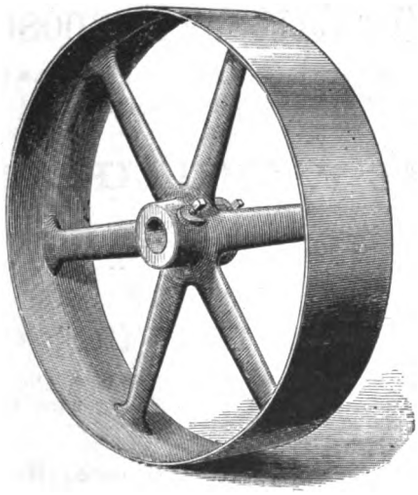
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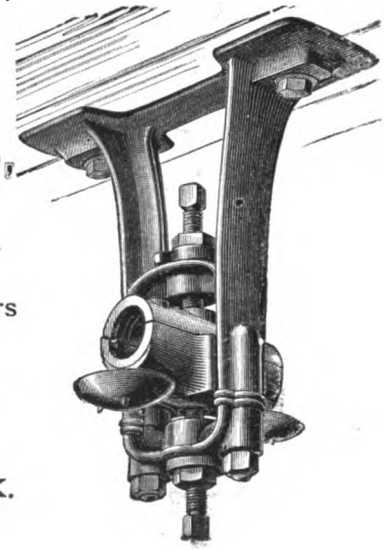

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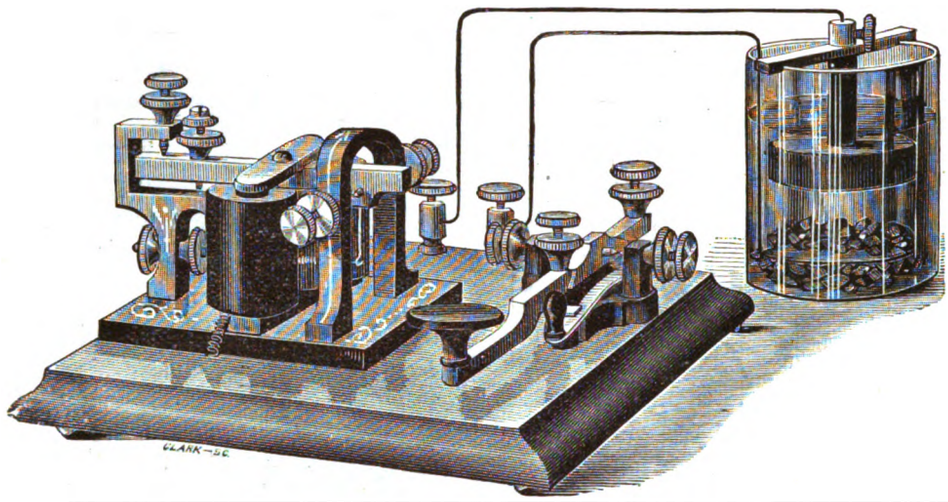

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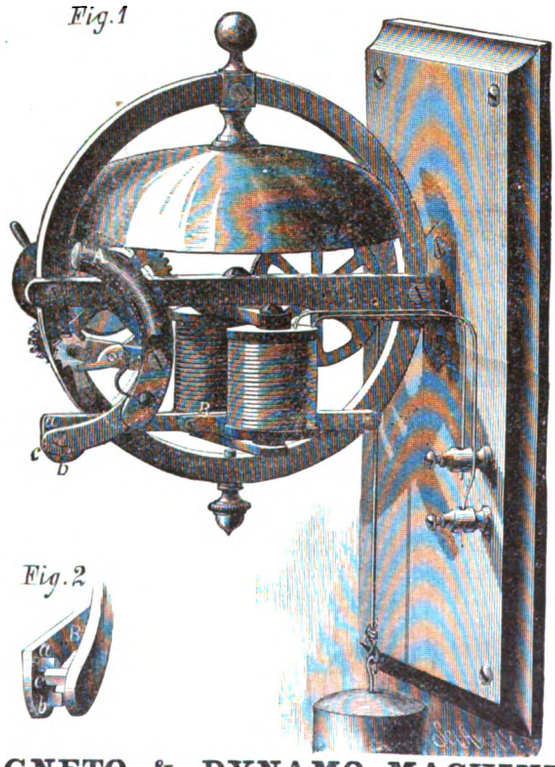

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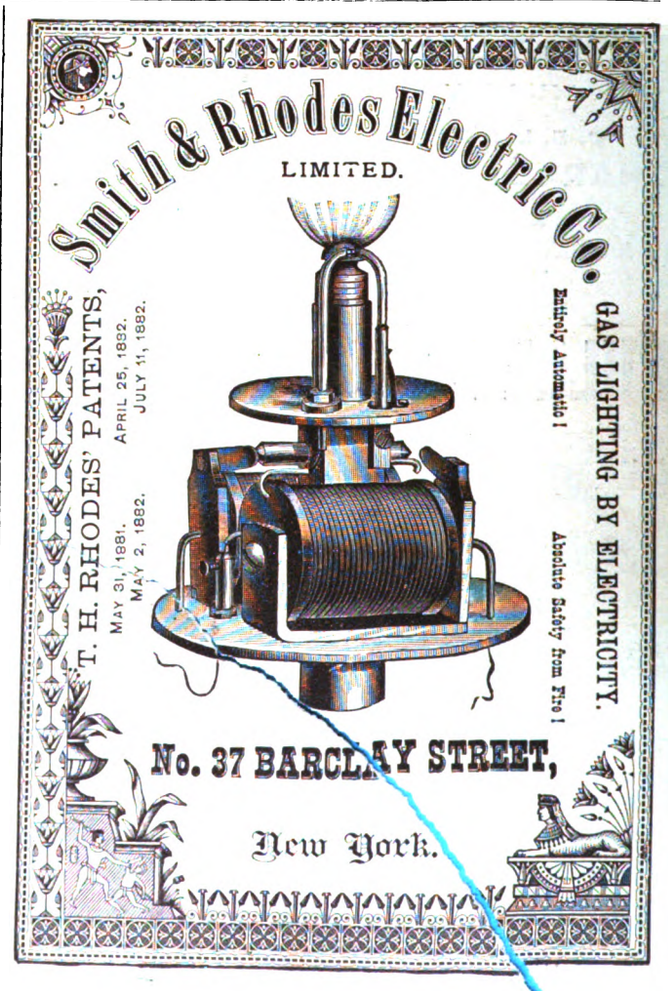

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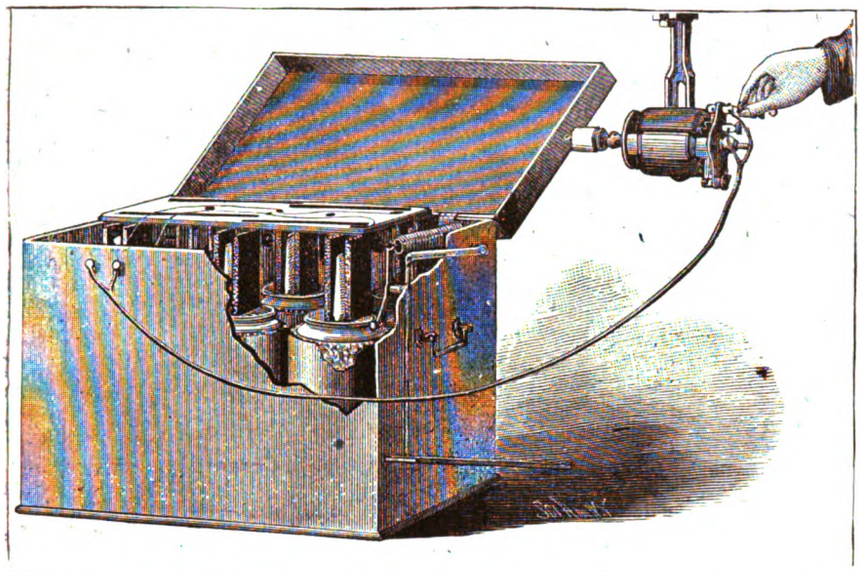

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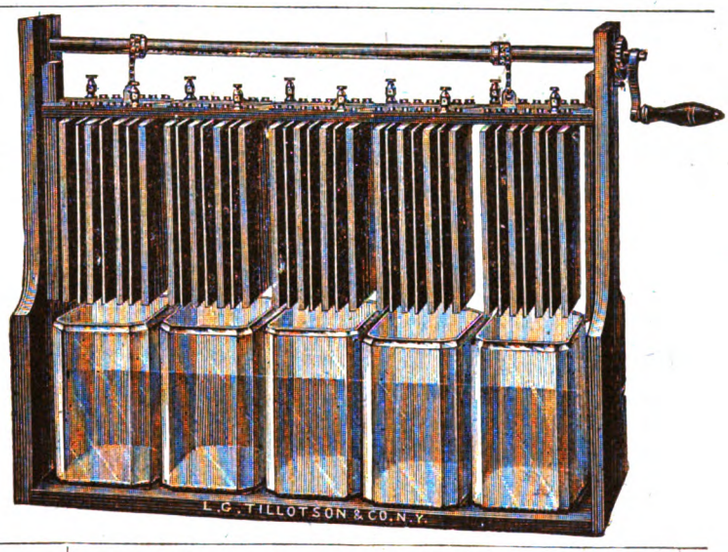

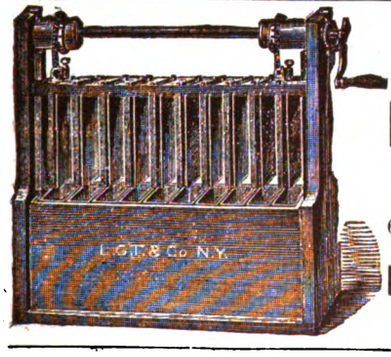

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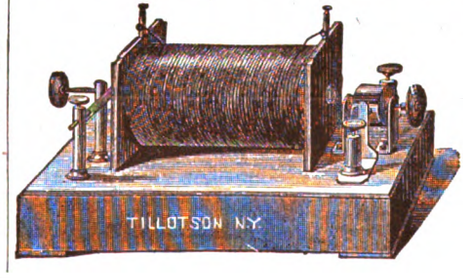

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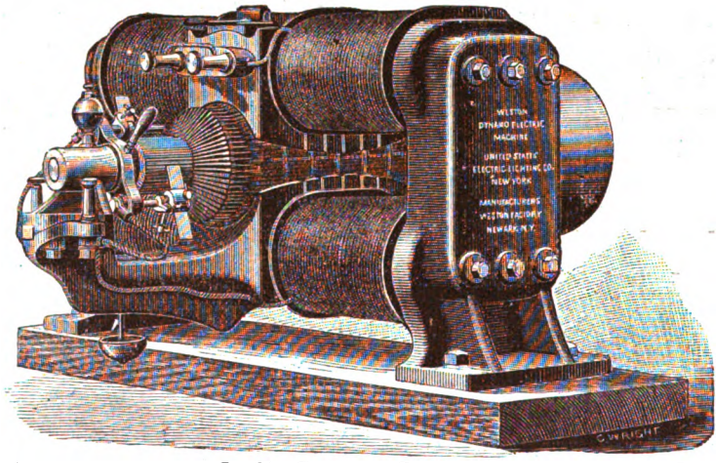

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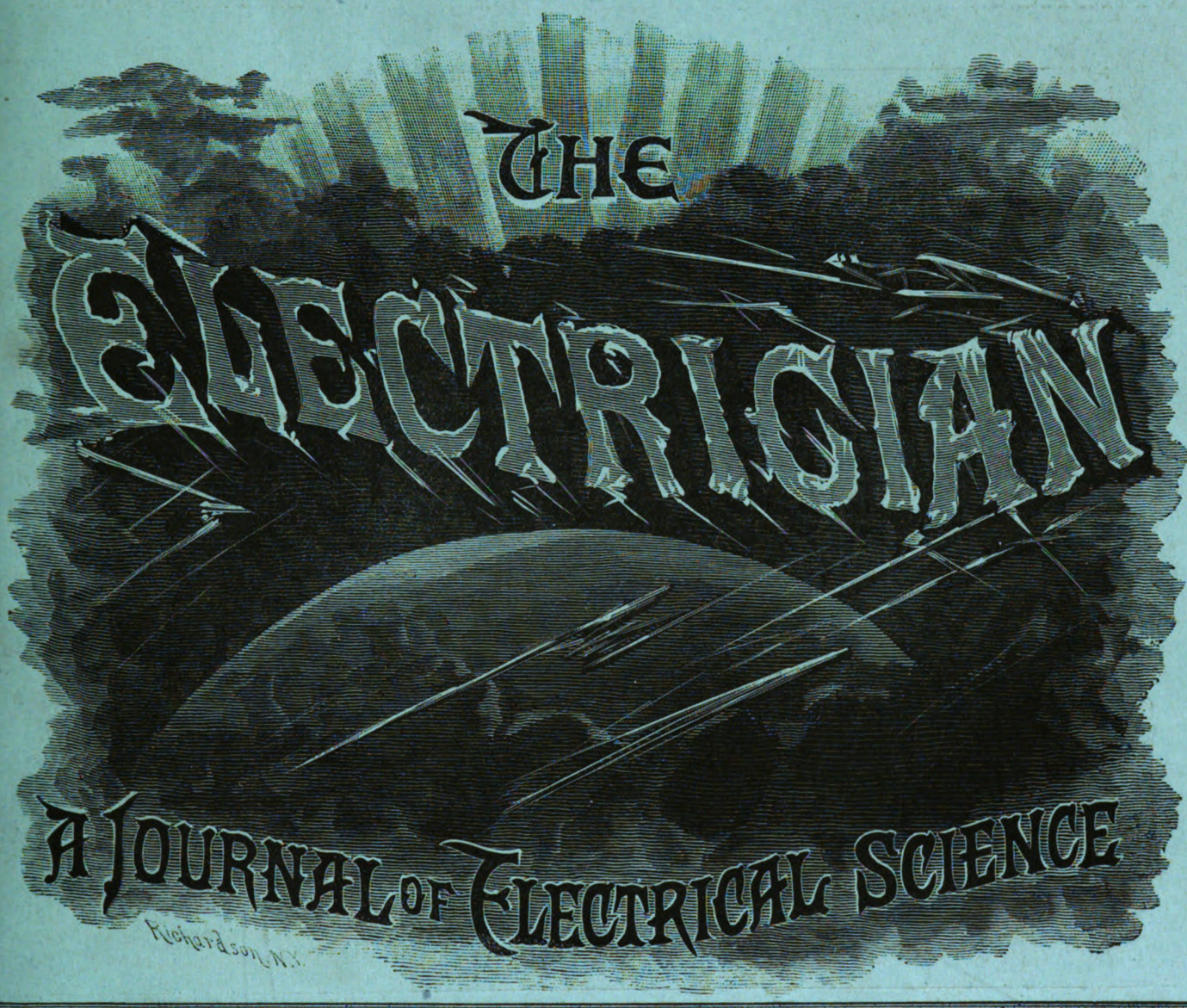

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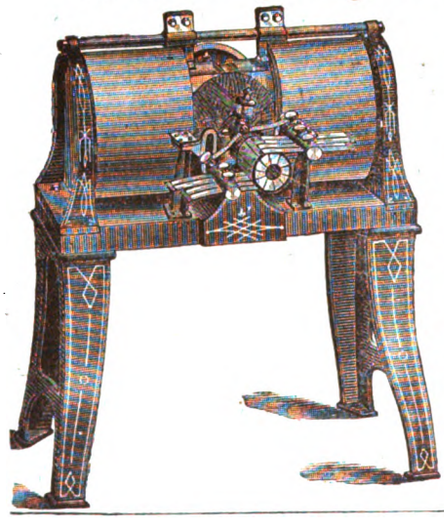

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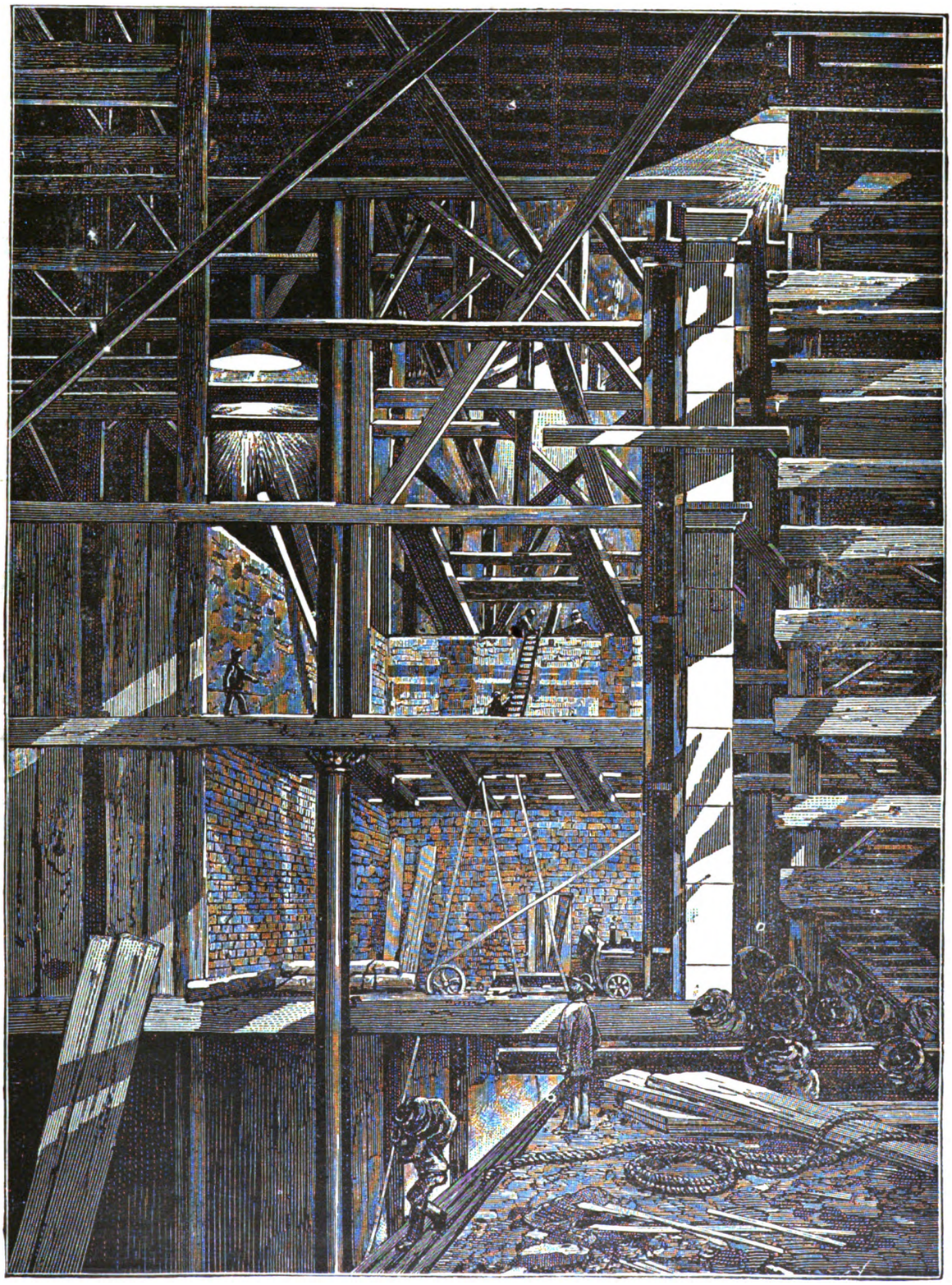

WORKING BY ELECTRICITY.—See page 30.

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WORKING BY ELECTRICITY.

AMONG the despatches, recounting the Milwaukee holocaust, was the following: "To night all is dark and dreary at the scene. The authorities have not provided electric lights, despite popular clamor on the subject. Not a single body has been found yet." It may be somewhat hasty to blame the public authorities; but that philosophic spirit, which allows the victims of some great disaster to lie smouldering in a heap of ruins, until they can be slowly extricated by day light, is not one to be either commended or encouraged. How often do we not hear of mills working day and night, of night relays, and of a due appreciation of time—even night time—when money was to be gained?

Darkness adds immeasurably to the horror of such calamities, for relatives and friends have to await the sun, before the work will be gone on with. We saw this in the Potter fire building, and we are doomed to see it again, for, although our municipal departments cost more than any other in the world, they display a lamentable lack of prompt aid and charity. "There is no money for such purposes." But, there is no necessity that such works be carried on only in the day time; the electric light can as well be used for clearing away the rubbish of a fallen building, as in erecting a new one. The illustration gives an actual example of the use of the electric light for the latter purpose. It is now largely used in Paris, in carrying on building. The intense heat of a portion of our Summer season, would even render night building a most commendable innovation, for the bricklayer is peculiarly exposed to insolation—the attraction of the bricks, the dizzy height, the exposed situation, are all elements of danger.

But people, some at least, prefer to remain in darkness; this is, however, so common to human nature, that one of the Hebrew commentators draws an illustration from it. "Does anybody awake, shortly before the morning, when everything is yet in darkness, he asks a servant to give him a light, but it immediately extinguishes; then he has another lighted, and is preceded by it, but this one also goes out, and he sits in darkness again, then he thinks to himself: 'Now will I wait till the clear light of morning dawns, then I can see clearly.'"

Perhaps that has been the sentiment also of the Milwaukee authorities.

NEW TELEPHONIC APPARATUS.

FROM the first, Mr. G. Bell has insisted that telephones, in which both poles of the magnet act upon the vibrating diaphragm, at the same time give the more intense sound, and the variety called the "Carre Model," has always been considered as the superlative among telephones of this class; but as these apparatuses are not portable, and as they are far more expensive than the ordinary, little, straight magnet telephone, they are less extensively employed.

However, Messrs. Phelps, Gray, Siemens, Gower, and Ader, seeking to render the horseshoe magnet telephones portable, have created certain well known varieties, which give very good results. But since the manufacture of horseshoe magnets is necessarily expensive, and their adjustment difficult, in consequence of their distortion during the tempering process, their price has continued always relatively high, and it has been long desirable that a means should be devised of rendering the construction of these telephones so simple that they could be sold at the same price as the straight magnet telephones. This was the problem that Mr. Kotyra has quite successfully solved.

In this system, the horseshoe is constructed by the combination of thin strips of hardened steel, of different lengths, cut from the same sheet, and so associated as to form a horseshoe electro-magnet. This manufacture is easy, for admitting that two of these strips, longer than the others, and placed together, as is shown at *AA*, Fig. 1, below, can be considered as the back piece of the electro-magnet, it is only necessary, in order to form the arms and holes, to fix upon its extremities, first, very short strips of steel, or iron, and upon these to superpose other sheets of steel, *NS*, a little less than half as long as the back piece, *AA*. At the extremities of these, and some millimetres[1] apart, are fixed the two iron cores, forming a vertical extension of the two poles of the magnet, and two bobbins, or coils, *BB*, dropped over these cores, completed the electro-magnetic system, of which no part need be forged, and which being magnetized, sheet by sheet, can be given a power vastly more energetic, and durable than a solid, single piece magnet. The rest of the system admits of the same construction as the ordinary Bell system; and the instrument can be given all possible exterior forms.

Mr. Kotyra has also simplified the manner of mounting the subscribers "posts," by enclosing, in the case of the telephonic transmitter, the commutator employed to put the line in connection with the call bell, or the telephone.

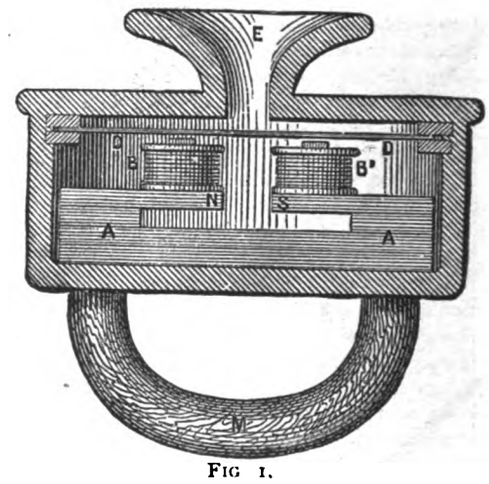

FIG 1.

This telephonic system can naturally operate either with, or without a battery, but up to the present time Mr. Kotyra has preferred to use for the transmitter a telephone of the same system, to which he gives larger dimensions, and which he fixes in such a position that it is presented toward the speaker at a certain angle, like the desk transmitters, which are the most extensively distributed, The apparatus appears, therefore, as it is shown in Fig. 2, and the telephonic receivers are suspended on arms, extending from the inside of the circular box of the transmitting telephone, and connecting with the commutator in the same manner as in other systems.

The semi-circular handles, seen below the telephones, are made simply of wood, and have no such relation to them as the handles of the "Ader," and other telephones, which are extensions of the magnets themselves.

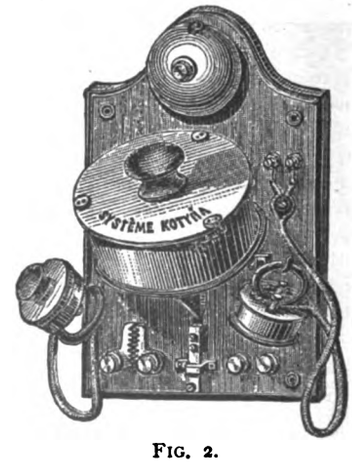

FIG. 2.

The Kotyra telephones have been tried with success upon the Northern line; by means of them, a correspondence has been transmitted from

1. 1,000 millimetres = 39⅜ inches.

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Paris to Creil, and it appears that the small model can be applied upon lines six kilometres (6,561 yards) in length. The inventor has, in addition, modified the disposition slightly, in order to reduce their dimensions, without diminishing their power. On the other hand, he has constructed a more powerful model, which acts upon both ears at the same time. I shall explain these improvements when the rights of the inventor are wholly protected.

D'ARGY'S MICHROPHONIC SPEAKER.

This transmitter is founded upon the same principle as that of Mr. Bourseul, of which it is, strictly speaking, merely an improved form. The Bourseul apparatus consists, as is well known, of two plates of wood, mounted parallel to and opposite each other, upon two plates of rubber, and which are connected by two little cylinders of carbon enveloped by a rubber tube. At the point of contact of the two carbons, is introduced a certain quantity of powdered coke, or other poor conductor, which is kept in place by the rubber tube, which also serves the function of pressing the two extremities of the carbons together.

Mr. D'Argy has modified this apparatus in the following manner: the two cylinders of carbon, together with the powder between them, and the rubber envelope, form a single cylinder of about one centimetre (about half an inch) in diameter, which is fixed to the vibrating diaphragm by one only of its extremities, and this diaphragm is constituted of a thin plate of spruce, forming the cover of a sort of flat box with an enlarged bottom, which is suspended vertically by two little strings—leather thongs. This box is steadied against the wall by the intermediation of four little pieces of thin cloth glued to the four corners of the box. The extremity of the carbon cylinder is flush with the exterior of the spruce diaphragm, and the whole is varnished and fixed in such a manner as to avoid any need of regulation or adjustment.

Mr. D'Argy employs no induction coil, and, if it can be believed, he obtains a very clear reproduction of the speech without any "frying" under the influence of a single little Leclanché cell, and by the use, as receivers, of common telephones, costing only fifteen francs (about three dollars) a pair. "At a distance of six metres" (about six yards) says he, "an air played by a little music box, is perceptible without the loss of a single note, but he does not indicate the distance to which transmission can be carried with this apparatus.

TELEPHONIC SYSTEMS OF MR. BOUÉ MONTAGNAC.

Mr. Boué Montagnac has been, for four years past, endeavoring to perfect the telephone and has undertaken numerous experiments, which have led him to discern certain new principles in the telephone, upon which he has based several systems of apparatus.

In the first place, for microphonic transmitters, he has recognized that, far from being necessarily impressionable to the same degree as is generally admitted, the semi-conducting contacts of multiple carbon transmitters must be susceptible to impression in different degrees. Consequently, he constructs them with carbon rods, of diameters progressively decreasing; pretending that by this disposition, if the sonorous impression is not sufficiently powerful to influence the larger, it must always be capable of influencing the smaller. On the other hand, to obtain a more decided obedience from these elements of the instrument, and at the same time to augment their sensibility and certainty, he arranges them to be movable on one side only; for, while fixed upon the frame of the apparatus, it is by their other extremities that they are put in relation by a bar of graphite, upon which they all rest, with the vibrating membrane, which consists of a sheet of cork.

The points of contact of the ends of the bars, which are fixed upon the frame, are constituted of little square blocks of graphite, isolated one from the other, and each separately communicating with a special battery. The upper cross-piece of graphite, fixed upon the vibrating membrane, is supported on the side opposite to the membrane, by a very feeble spring which conveys the current, and which itself forms microphonic contact, by reason of the pressure, more or less great, that the vibrations of the disc produce between this spring and the cross-piece. The whole is maintained in an inclined position, as in the systems, Ader, Gower-Bell, &c.

It appears, that the comparative trials of this system, made by Mr. Boué Montagnac, have shown great superiority, as regards sensibility.

The telephonic receiver of M. Boué Montagnac, is a little more complicated, for he arranges it, first, so that several induced currents are caused to act upon a single membrane; second, so that for the permanent magnets, electro-magnets may be substituted, the power of which can be regulated; third, so that his vibrating plate is made a condenser, with reference to a layer of air that is put in relation with the induced current.

To realize this disposition of its constituent parts, he employs two metallic diaphragms, fixed one above the other, and separated by a sheet of paper, and he maintains them by bands of rubber. These diaphragms, one of which is iron, and the other zinc, are put in relation with the line circuit before its junction with the electro-magnetic coils. The apparatus, instead of being circular, is oblong, to permit the inclusion, in the box below, the diaphragms of a three-pole electro-magnet covered with two superposed helices. One of these helices receives the current from a local pile, to magnetize the electro-magnet constantly; the other is connected with the line, and through it, with the zinc sheet of the condenser, constituted of the two diaphragms. According to the inventor, it appears that, under these conditions, not only can a message be heard a great deal better than with ordinary telephones, but the inclusion of the condenser in the electro-magnetic system, reinforces the sound in a very considerable degree.

With a wire three kilometres in length (about 3,280 yards), and about No 44 (about 24,000 ohms resistance), says he, "the current from my transmitter goes directly to the bobbins of the receiver, without connection with the plates of the condenser, without making it very difficult to hear a message; but when the connection is effected, then the hearing is perfectly clear. With a No. 16 wire, 265 metres (about 290 yards) in length, I can hear words just as well, whether the bobbins are connected with the condenser or not," from which fact, I infer, that for great distances the inclusion of the condenser can be very advantageous for the reproduction of words.

It is to be regretted that no experiments upon telephonic lines have been made, to positively determine the merits of this system.

Further than these single instances, telephonic developments are announced every day, which, if appreciated, might develop a more rapid progress of the telephonic art. Thus Mr. Chabirand advises us, that the large mirrors, or windows, of apartments, can be advantageously employed as microphonic organs. It suffices to insert little contacts of carbon under the wainscoting of the frame, and upon the edges of the glass, to resolve the problem. Under these circumstances, can be heard everything that may be said in the room; but the use of such an attachment can be rendered discretionary, by inserting a switch in the circuit, which may be opened or closed at pleasure.

It is certainly impossible, to foresee the extent to which future developments will progress the telephonic transmission of sound; and again and again we ask, in wonder, how a telegraphic system, whose elements are so simple, could elude discovery until this late day.

TH. DU MONCEL,
In *La Lumière Électrique.*

—— A YOUNG MAN in one of the outlying districts of Detroit, took an unwarranted liberty with the telephone the other day. A big bumble-bee one warm day came bumbling into the office through the window, which was open, and was caught and placed in a tumbler by the young man, and the tumbler placed over the orifice of the transmitter. He then rung up the central office, and, with the telephone to his ear, awaited the result. "Hello!' came in response from the other end of the line. "Bum, bum, bur-r-r," buzzed the bee in return. "What's that?" "Bum, boom, buzz, burr-r-r." "I can't quite understand. You'll have to repeat that." "Bum, buzz, whir-r r," went the bumble-bee. "Oh, talk United States, you bloody imbecile! Didn't you ever use a telephone before, you idiot?" yelled the enraged operator. A renewed and more frantic buzzing was the only response. "Go to thunder, you bull-headed old fool!' came sizzling over the wire. No response. "Something's the matter with your blasted old box. I'll send a man around to-morrow to fix it," came from the central office man, and then a "click," as he hung the instrument back on the hook.

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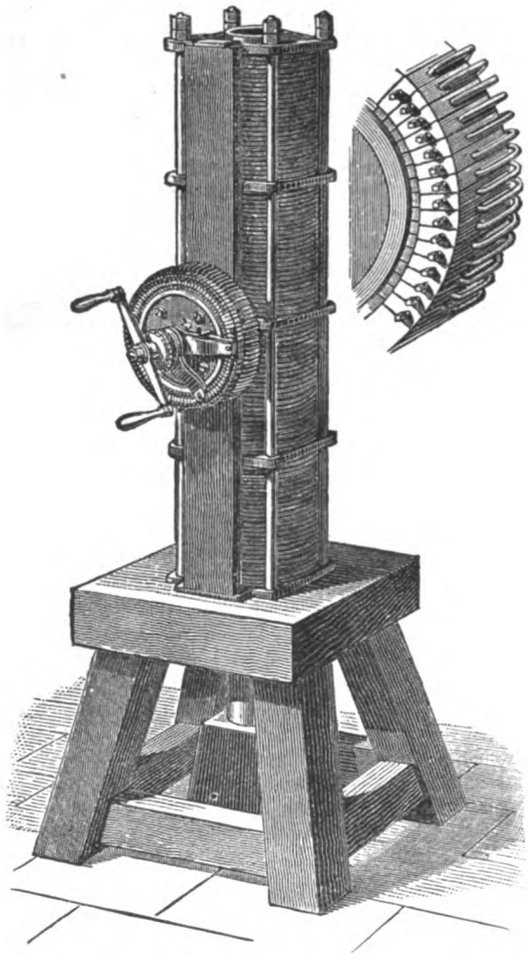
ELECTRIC HAMMER.

WE translate from *La Nature:* "Among other services that may be obtained from the transmission of electricity, its adaptation to machine tools is not the least important and interesting. This readiness of electricity to yield itself to the most varied changes, renders it one of the most valuable aids for industrial purposes."

The tendency, at present, in a large number of work shops, is to do away with ordinary transmissions, and to substitute for them a steam conduit that will bring power directly to each tool. The steam hammer is the type of this kind, and the apparatus of M. Marcel Deprez, shows that electricity can render services that have been hitherto exclusively reserved for steam.

The electric stamp hammer, represented in the illustration, must be considered as an experimental apparatus; it worked, however, during the lectures given by M. Deprez, at the Conservatoire des Arts et Métiers.



NEW ELECTRIC HAMMER.

The electric hammer is composed of a solenoid, of 39 inches in length, formed of a series of flat superposed bobbins, forming a hollow cylinder, in which a second cylinder, weighing about 55 pounds, can freely move. The flat bobbins, to the number of eighty, are so connected together that the out wire of the first is joined to the entering wire of the second, and so on. All these bobbin connections, meet in the keys of a circular commutator, the working of which we shall see later on. The *ensemble* of the system, bobbins and commutator, represents, in principle, a Gramme ring, developed under a rectangular shape, and joined to its circular collector. Two brushes moves under this collector, forming such an angle, as to embrace about ten of the commutator keys. These keys move together, and are worked by means of a double griff, or handle. The communications between the two brushes, and an outside source of electricity, are so arranged that the current enters at one of the brushes, and leaves by the other, after having traversed the ten bobbins corresponding to the ten commutator keys, interposed between the two brushes.

Let us suppose, that at the beginning of the experiment, the cylinder, in the solenoid, is resting on the anvil, and that the current passes through the ten lower bobbins, the hammer—as we will call the moveable cylinder—will be raised to a certain extent, so as to come to the region traversed by the current, and in a certain position, that will depend on the weight of the cylinder, the intensity of the current, and the general conditions of construction.

If the commutator is turned in a certain direction, as from right to left, the current will cease passing through 1, 2, 3, *n*, lower bobbins, and will go through 1, 2, 3, *n*, bobbins above the tenth. By reason of the action of the solenoids on the soft iron, the hammer will be raised so as to come every moment into the region of the solenoid that is traversed by the current. The inverse movement of the commutator will produce the inverse effect—that is, the descent of the hammer. These movements of the hammer, and the shocks produced by the fall, may be varied in speed and power, by a suitable manœuvre of the brushes; a sudden shock may be obtained, or the hammer may be stopped so near the anvil as to break, but not crush a nut; in fact, all the experiments that have been done by the steam hammer can be effected by this ingenious system. By varying the number of the solenoid sections, comprised between the two brushes of the commutator, the power of the hammer may be changed at will, and the best working conditions ascertained. With an intensity of 45 amperes, and fifteen sections interposed between the brushes, the effort developed on the cylinder will reach 152 pounds, or nearly three times the weight of the hammer. This power was shown when it was sought to make the hammer descend from the top of its run, where it was kept by the current. The wooden frame, would, of course, be replaced by a suitable iron stand. The illustration shows only the primitive machine.

ELECTRO-GENERATIVE BRICKS.

ELECTRIC candles and small bricks, or briquettes that will give both heat and electricity, may soon be a very practical form of electricity. It is not altogether out of the range of possibility, that the man of the near future may quietly remain in bed of a morning, and light by electricity his fire of electric bricks; thus saving time, rest and temper, and doing away with ashes, dust, fire-lights, wood and coals.

Dr. Brard, of La Rochelle, claims to have made a great advance in the making of such candles and bricks.

"The idea of utilizing the action of melted nitrate of potash on coal, which had been previously rendered incandescent, is not a new one," writes M. Niaudet, in *L'Electricien*. Becquerel was the first who had the idea, and made the experiment. It is very evident that, under such conditions, the coal is burned by the oxygen of the nitrate. M. Jablochkoff repeated the experiment in 1877, without knowing that it had been previously made. Dr. Brard has now repeated the same idea in principle, if not in form. He first made an electro-generative candle, but it burned too rapidly, in fact, lasting only for a moment.

He next adapted the brick form; this brick, Fig. 3, has the following dimensions: 15 centimetres long, 35 millimetres in width, and 25 millimetres in thickness. Two strips of brass protrude from it, and these are the electrodes of the pile. The skeleton of this hollow brick is made of artificial coal, composed of coal dust, that is agglomerated by means of molasses, or a paste of coal tar. This mixture is compressed in metal moulds. Metallic wires are put in the paste, and these end in the negative electrode. These wires are represented in Fig. 2. The mould is made so that the brick shall be perforated, through its entire thickness, with numerous cylindrical holes, of which Figs. 1 and 2 will give an idea. These holes are to hasten the combustion, by enlarging the surface of contact, between the coal and the nitrate. The combustive body is a mixture of nitrate (one part), and ashes (three parts). It is placed on the upper part of the brick, and kept there by means of a sheet of asbestos, of from $\frac{5}{10}$ to $\frac{4}{10}$ of a millimetre in thickness. The mixture is heated

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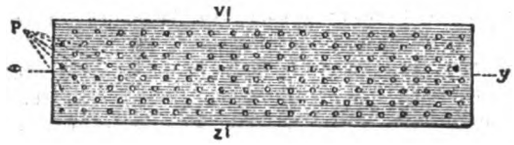


FIG. 1—PLAN VIEW OF THE BRICK.

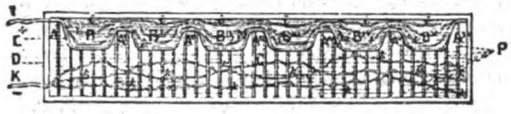


FIG. 2—SECTION OF THE BRICK.

until it becomes sirupy, and then poured on the asbestos. The electromotive power of this element, is about 1⅛ volt.

M. Niaudet does not believe much in electric bricks, or in electric stoves, but really, what to believe, and what not, are things whose number is for ever increasing.

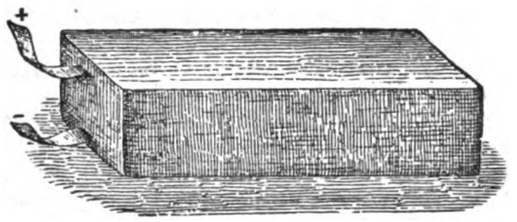
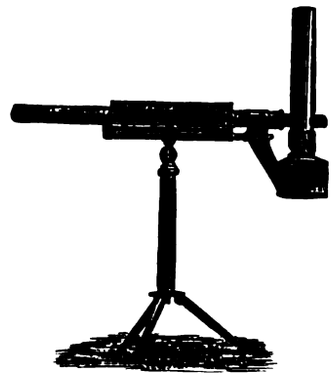


FIG. 3—THE BRICK.

A WEDGE AND DIAPHRAGM PHOTOMETER.

A NEW photometer, shown in perspective in the figure, has lately been constructed by Mr. Sabine. The stand supports a straight horizontal tube, at one end of which is a paraffine lamp, and at the other, an eye-piece. The middle portion of the tube is cut away, and has, slipped over it, a collar to which a frame is attached, carrying a wedge of neutral-tinted glass, adjustable by means of a rack and pinion. Inside the collar is fixed a transversed disc of ground opal glass, which the paraffine lamp illuminates to a definite degree. This disc constitutes the field of comparison, the illumination of which is adjustable by means of a series of diaphragms, of known aperture at the end, near to the paraffine lamp. At the side, between the wedge and the collar, which carries it, is a narrow pane of ground opal glass, just behind which a small mirror is fixed, at an angle of 45°, to the axis of the tube. This mirror is supported from the centre of the transverse opal disc in such a way, that the support is hidden from the observer by the mirror itself, an arrangement which insures the apparent juxtaposition of the illuminated surfaces, which have to be compared. The light to be measured is placed on the right hand side of the photometer; and the collar is turned, so that the light falls normally upon the face of the wedge, passes through the wedge, through the pane of opal glass, and is incident upon the mirror, which reflects a portion of it to the eye of the observer. The wedge is then shifted, if necessary, to interpose a greater or less thickness of absorbing medium, until a balance is obtained—that is, until the apparent illumination of the mirror is equal to that of the field of comparison, in the middle of which it is seen. If the range of the wedge, is insufficient to admit of this, the degree of illumination of the field is altered, by means of the diaphragms, and the wedge is then adjusted.

The employment of glass wedges, for photometric comparisons, is not new, having been already used by both Xavier de Maistre and Quetelet; but no practical photometer based upon this method has hitherto been constructed. The employment of diaphragms for extending the range of the wedge, is found to work well, and to enable the operator to adjust the illumination of the field with exactitude, the bright part of the paraffine flame being, of course, kept opposite to, and so as to well cover the diaphragm aperture. A table is constructed, giving for each position of the



wedge, and for each diaphragm, the value, in standard candles, of any light placed at a distance of one metre from the instrument; and if the light be placed at any other distance, the number in the table has simply to be multiplied by the square of the actual distance in metres. For ascertaining approximately the amount of light which passes through any given colored glass—for example, orange glass—the eye-piece is furnished with a rotary disc, containing small panes of white and different colored glasses, either of which can be interposed at leisure.

This photometer is being made by Messrs. Elliott Bros., in two forms, one for use as a portable photometer, as shown in the figure, and the other on a more solid stand, for laboratory purposes.—*London Electrical Review.*

IMPROVED ELECTRIC BELL.

WE learn from an English paper, of an improved form of electric bell, recently patented by Messrs. Gent & Co., of Leicester, England. The main feature in which it differs from electric bells of ordinary construction, is the substituting for the armature usually moving against the face of the ends of a magnet, an armature suspended over its

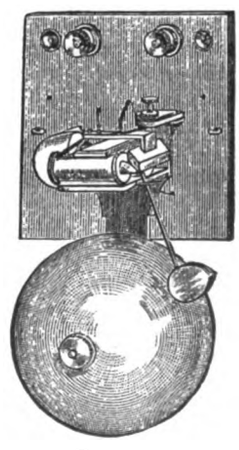


FIG. 1.

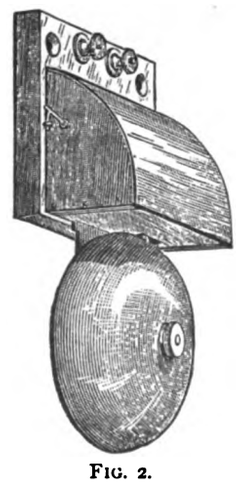


FIG. 2.

projecting poles. As seen in the engraving, they are inclined so as to present a large magnetic surface; while, by this mode of suspension, the armature rests with its face at equal distances from the face of the projecting poles at all points—the peculiar form of spring allowing the armature carrying the hammer to approach at a uniform angle. The power exerted upon the armature is said to be greater than in the ordinary form with a smaller quantity of wire in the coils, sufficient power being obtained to powerfully ring a 4-inch or 5-inch bell, with a magnet, whose core is only a quarter of an inch in diameter, and wound with about three ounces of fine wire.

The whole is mounted on a metal frame, which is itself attached to a small wooden back, the magnet being enclosed and shielded from dust by a quadri-circular cover. As we understand that the cost of the improved bell is, especially in the larger sizes, less than the ordinary forms, it will no doubt meet with the favor it deserves.

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ON LIGHT AND THE EYE.

ON the 28th of December, Prof. Tyndall commenced a course of six lectures, addressed to a juvenile auditory, at the Royal Institution, London, on the above subject: Christmas juvenile lectures were begun, he remarked, by Faraday, exactly 55 years ago. Probably none of the boys and girls present had ever seen Faraday. If they had seen him they would not soon have forgotten him, and he was, no doubt, well remembered by the boys and girls, now men and women, who had the privilege of hearing him. When he was getting on to 70, he used still to call himself a "juvenile," and so Faraday was, for his heart never grew old. He always tried to make this Christmas course as simple as possible, and, Prof. Tyndall added, he would himself try to follow his predecessor's example. He should, therefore, address himself to the youngest of his hearers; but to enable the older boys and girls present to go more deeply into the subject, if they wished to do so, he had placed in the hands of every one of them his "Notes on Light," which he took great pains to write briefly and clearly some years ago. The sun, of course, was our oldest source of light. We did not know when fire was first discovered by human beings. It must have been long before history began to be written, and it was probably first used as a source of heat, and not until some time afterwards as a source of light. The means of illumination employed, at the present hour, in certain parts of Ireland and Scotland were very primitive. They took a common rush, and peeled it, so as to expose the soft, spongy pith, leaving a narrow strip of the peel behind, so as to hold the pith together. Tallow was then melted in a pan, and they passed the peeled rush through the liquid grease. Thus we had the rushlight employed, the lecturer believed, to this hour, in many parts of the United Kingdom. It was soon found, that after the first grease coat had hardened, the rush could be dipped again, and covered a second time with tallow. The process being repeated, a good, thick stem of tallow surrounded the central rush, and there, on the table, they had lighted rushlights of the kind. We had now advanced from tallow to wax, to stearine, and paraffine, as they saw, and had thus wonderfully improved candles. Wax must have been thus used in Swift's time, for in a famous fable, the witty Dean makes the bee boast, to the confusion of the spider, that whatever his own busy tribe had got, had been gained by infinite labor and research, and by ranging through every corner of nature; the difference between bees and spiders being that instead of dirt and poison, the bees had rather chosen to fill their hives with honey and wax, thus furnishing mankind with the two noblest things—sweetness and light. It was experimentally shown that the unprotected flames from our candles, gas, and paraffine lamps emit much smoke, which was eliminated when a draught was created by the use of a chimney. The brilliant Empress lamp was smokeless, though without a chimney, the draught being produced by an ingeniously contrived fan. Exceedingly hot flames had been discovered, which gave hardly any light, until some solid body was placed in the flame. Such a flame was that of hydrogen gas, which, however, at once became highly luminous, when a platinum wire was plunged into it. In the same flame a pipe shank was quickly raised to a white heat. Still more intense was the oxy-hydrogen flame, as was shown by the instant dissipation of a small round file into a shower of sparks, and of which the Drummond light was an early illustration. The fact that a platinum wire becomes more and more intensely incandescent, by the passage through it of repeated electric currents, had been known for three quarters of a century. But it was only the other day that he saw at the Crystal Palace how admirably it had been turned to account in the Lewis lamp. The platinum was here wrought into an extremely fine gauze, of which the inventor made a little cage, putting into it a very hot flame, and producing the very brilliant light which they now saw. Swan's carbon fibre was ignited in three groups by a battery of fifty cells, and, the gas having been extinguished, the theatre was afterwards illuminated by the Swan lamps presented to the Institution some six months ago. The light used for the next experiments, Prof. Tyndall explained, would dazzle the audience too much if placed naked before them, but he would cause it to stamp its own image upon the screen. The image of a pair of carbon points was then shown as passed through a pinhole first, and afterwards through a lens. A whole regiment of such points was next seen to be transmitted. The rebound of light on striking a smooth surface was demonstrated. The beam of light passed through the pinhole and could not be itself seen, but only the particles of dust in the air which were illuminated by it. On burning this dust with a spirit lamp, black specks, like smoke, were produced by the flame, which yet was smokeless. The law known to the ancients, of the equality of the angle of incidence to the angle of reflection, was demonstrated by ingenious apparatus, devised by the lecturer's assistant, Mr. Cottrell. An experiment of the same kind, as that by which Prof. Pepper produced the well-known ghost, illustrated the relation between transmitted and reflected light. Between the busts of Newton and Lord Bacon was introduced, by an optical illusion, that of Mary Somerville. The explanation of the law of the kaleidoscope, and of the laws of reflection from angular and curved mirrors, followed.

Prof. Tyndall stated, in the second lecture of the course, that, according to Foucault's later experiments, the velocity of light was more than 185,000 miles a second. This would be the distance run in 258 days by an express train traveling day and night, at the rate of thirty miles an hour. A word on shadows and penumbras or half-shadows followed, illustrated by simple experiments. Owing to the motion of light in a right line, opaque bodies were found to cast shadows. A wand was fixed upright on the table with the flame of an Empress lamp turned edgeways upon it. The dark shadow was at once visible on the screen, but, as was pointed out, there was no penumbra. But on turning the flame face onwards, the shadow was dark at the core only, with a parallel streak of fading penumbra on each side. When the light emanated from a point, the shadow of a sphere, placed in the light, was a divergent cone. The bearing of these and other simple facts on the phenomena of eclipses was illustrated by diagrams. The law of actual inversion of the image in a mirror, Dr. Tyndall demonstrated in its most elementary form, by calling attention to the change in direction of the parting of his own hair as reflected in a looking-glass. He next spoke of refraction, which he expounded with constant reference to what is known as Brooke's model, illustrative of what happens when a ray of light passes from air into water. He showed that there was a limiting angle answering to the particular obliquity which caused the ray to graze the surface after quitting the water. It was next asked, what became of the rays having a greate obliquity than that answering to the limiting angle. The diagram would show that they never left the water at all, but were totally reflected at the surface, where air and water touched. The verification by experiment followed, demonstrating the phenomenon of total reflection in the circular cell, with the help of the rectangular prism. The carbon points having been inverted, a beam of light was next deflected at right angles to itself, teaching, that when light passing through water strikes very obliquely the surface, where air and water meet, it cannot escape from the water. Supposing, said the lecturer, he let water spout from the vessel to which he pointed, and supposing, further, that by means of a little glass window at the back of the vessel, he sent a beam of light through the water, concentrating it upon the orifice through which the water flowed, that beam would strike the surface of the jet of water so obliquely, that it could not escape from the water but would be carried down, just making the jet look like molten metal. The illumination of the liquid vein by interna reflection and with rays of various colors was then given, and was received with rapturous applause. The different kind of lenses were described, and their applications experimentally illustrated. In the magic lantern, to which Dr. Tyndall soon passed, there was a combination of lenses One was used purely for the purpose of illumination, the others for the repro duction of the illuminated object in the image on the screen. The slides used for the magic lantern reproduced instantaneous and transparent photographs of the Niagara Falls, rapids, glaciers, and icebergs. Before concluding, Dr. Tyndall said, he wished to make, in their presence, an experiment on sound, bearing directly on his subject. He had there a gas weightier than air, a gas through which sound moved more slowly than through air. This gas, called nitrous oxide, would, he expected, act upon sound exactly as a convex lens acted upon light. He had also another gas much lighter than air, and through which sound traveled

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more swiftly than through air, This latter gas, called hydrogen, would prove, he thought, the direct converse of the heavy gas. The professor then applied these sound lenses, as he styled them, experimentally. Having shown the sensitive flame, and illustrated its behavior, he brought it near to the flaring point, when the reed sounded. He next brought a bubble of nitrous oxide in front of the reed. The heavy gas acted like a condensing lens, making the sound converge upon the flame, and causing it to flare and roar. He next experimented with the other gas, first augmenting the pressure on the gas holder outside, so as to make the flame flare when the reed sounded. He then introduced his light hydrogen lens. This gas at once scattered the rays of sound, so that the flaring flame was immediately stilled. Lastly, he shook in front of the table both the heavy bubble and the light bubble, when the one fell to the floor and the other rose to the ceiling. This experiment, he said, was important, because it showed that the waves of sound could be refracted, like light, and this prepared us for the result that light also might be due to wave motion. He said he deemed this a most striking and beautiful experiment.

ON THE HOMEING SENSE IN MAN AND ANIMALS.

L'Electricien has an article on the above subject, from the pen of M. Gariel, which will be found interesting not only to the naturalist, but to the electrician and general reader. It is herewith translated :

The *Revue Philosophique* published an article by M. Viguier some time ago, which was reproduced in *Revue internationale des sciences biologiques*, and appears worthy of a notice in this publication We must, however, confine ourselves to one side, in giving a *resumé* of his views.

The author lays down the question very squarely at the outset. "In different species of animals, and in certain men, more or less bordering on the savage state, a remarkable faculty has been observed, which enables them to return in a straight line from their point of departure, and this after having traveled long distances and described endless windings. There is no denial of the fact of these extraordinary returns at the present time; but there have been lively controversies and very opposite opinions as to the conditions in which they have been effected, and no unanimous views have yet been arrived at.

"We need not relate the facts proving the reality of these extraordinary returns, we will only cite that of the dog of the Archduchess Marie Régnier, which, carried *by rail* from Menton to Vienna, returned *on foot* from Vienna to Menton; and that of Captain Dunder's ass, which, brought *by sea* from Gibraltar to Cape Gata, returned *by land* from the latter point to Gibraltar. However singular these facts may appear, they cannot be gainsaid.

"Various explanations have been given, but besides that they are far from meeting the objections that will naturally arise, they do not relate to the questions treated of by this paper. M. Viguier returns to, and develops, an anonymous article which appeared in the *Quarterly Review*, 1872, attributing this quality to a special sense which endows animals with a more or less unconscious idea of the magnetic distributions at every point of the globe. Here is his full explanation :

"If we conceive that there are animals gifted with a sense, which enables them to recognize readily the direction of the magnetic north, such animals will have an undoubted idea of the north, but will not be able to return to their point of departure, unless they have an exact recollection of the length of line traversed in such or such a direction, exactly like a mariner sailing by reckoning, who has to keep inscribed the length as well as the direction of his loxodromics. But this would require a continual perception and a prodigious memory. Terrestrial magnetism will furnish us with other explanations. If we suppose that an animal is capable of perceiving the influences which affect the needle of a compass —the position of the animal remaining always practically the same with relation to the vertical of the place, it will be capable of recognizing those differences of intensity that caused the variations of the angle which is measured by the aid of this compass—an angle that varies, as is known, from 0 degrees at the magnetic poles, to 90 degrees at the magnetic equator. It could thus recognize the direction where this angle varies the most (magnetic, meridian, or isogonic line), and that where it remains steady (magnetic, parallel, or isoclinal line). Finally, there are other points of information which we obtain from our instruments, and which, we may suppose, are perceptible to an appropriate organ. I mean the variations of magnetic intensity. By uniting together all the points where this force is equally shown, we trace a series of lines (isodynamic), which are confounded neither with the isogonic or the isoclinal, although they are developed somewhat in the same way as these latter. It may be admitted, therefore, that a place may be determined by an animal, that is gifted with a magnetic sense, as complete as we have supposed, and this by the value of magnetic action in inclination and declination, as well as it would be, by us, from the intersection of a given isoclinal and isodynamic line. These magnetic conditions being once known, the animal would be always enabled to return directly to this point of departure, for it would be only by coming near it, that all the magnetic conditions would return to the value that they have in this place.

"The explanation is not absolutely impossible, but we confine ourselves to stating this curious hypothesis without trying to discuss it. M. Viguier, however, has endeavored to find out the special organ that could furnish this information, and how this organ is influenced by exterior magnetic conditions. According to M. Viguier, the organ is nothing else than the semi-circular canals of the inside ear ; they are narrow, semi-circular, and the planes perpendicular to themselves (one horizontal and two verticals). The reasons he gives for attributing this homeing sense to the semi-circular canals, are recognized by a certain number of physiologists who bring up some plausible facts in support of their theory. But, while physiologists attribute the quality to mechanical causes, M. Viguier believes he has discovered it in magnetic phenomena. He admits that terrestrial magnetism produces regular inducted currents in the endolymph of the canals, the intensity of which, varies with the position of these canals with relation to the direction of the needles of inclination and declination, and with the magnetic intensity. They would be inducted currents which the animal would feel, and which would give him an unconscious idea of the magnetic condition of the point where it is."

So far the article in *L'Electricien*, which states that the further reasons are physiological experiments which M. Viguier proposes, such as placing magnetized bars or currents near the head of a horse, by which, he believes, the animal would lose its ideas of place. Another experiment would be—with what are now termed "homeing" pigeons—some to have soft iron, and others magnetized small bars on the side of the head ; according to Viguier s theory, the latter could not find their way home. A pile placed on a horse, and sending a current to wires, or solenoids, placed parallel to the canals mentioned, would form another experiment.

THE Milwaukee hotel horror had scarcely been fully realized, when another calamity occurred. The calcium light, it should be well understood, is eminently dangerous Some years ago one exploded in Union Square, by which a few persons were killed, and several maimed. The Vienna holocaust has had the effect of awakening the authorities to the paramount necessity of having the safety of audiences insured, as far as possible. A similar movement has taken place in Germany—many defective places of amusement have been closed, and no theatres will, in future, be allowed to be built unless perfectly isolated, with ample means of egress, heated by steam from an outside building, and with no lights, except the electric. Some New York managers do not approve of the electric light, because it may interfere with spectacular effects. The many scares that have lately taken place in New York theatres, ought to serve as a warning. The explosion in Milwaukee was another instance of that criminal carelessness, which is almost a national characteristic. However, theatrical managers, and others, should be taught that it is no venial matter not to take all human precautions, when the lives of hundreds depend upon just such measures. That there are no laws to this effect might seem rather curious, were it not that we are not accustomed to see good laws enforced. The storage of such explosive gas on a stage, was highly criminal, and the responsible parties should be severely punished.

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We call attention, in another column, to the interesting contribution of M. Ph. Delahaye, the popular writer, in the editorial column of *Revue Industrielle*, "On the Progress of Electrical Science in France, in the Year 1882."

ELECTRIC LIGHT TESTS.

IN view of the conflicting claims made by the advocates of the different arc systems, now before the public, in regard to comparative efficiency, we think some consideration of the results of tests made at the Paris Exposition, may not be amiss, more especially as we are not aware that they have been hitherto published in this country. Much confusion has arisen in regard to the results of these tests, from confounding the paper contributed by Professors Ayrton and Perry, to *The Engineer*, on the subject of arc lamps, with the official report of the committee appointed to make tests and measurements of the different arc systems.

We notice that the Brush-Swan company has fallen into this error, in a circular recently issued, as the figures given correspond with those given in Professors Ayrton and Perry's report; but they do not correspond with those of the official report.

On the opposite page we publish a table, taken from the official report of Messrs. Allard, Joubert, Potier, and Tresca, the committee appointed to make tests and measurements of the various systems exhibited at the exposition. This table shows the results obtained from experiments with the different types of continuous-current generators and arc lamps, and we have added to it some additional calculations, which we have made from the data given, for the purpose of bringing out more clearly certain points, which, we think, it may be useful to consider. The data given are not as full as could be desired, and it is to be regretted that the committee was not furnished with proper facilities for testing all the different systems by the same methods, and under the same conditions; but the measurements and calculations are by far the most complete and reliable which have yet been published, and the results obtained may fairly be taken as indicating the comparative merits of the different systems before the committee, when proper consideration is given to the meaning of the figures obtained.

These systems, as will be observed, comprised the Gramme, Jurgensen, Maxim, Siemens, Bürgin, Weston, and Brush. Measurements were taken of three different forms of the Gramme machine for running, respectively, 1, 3, and 5 lamps; and three different forms of the Siemens machine, for running 1, 2, and 5 lamps; and also two different sizes of the Brush machine—the 16-light and the 40-light.

Of the measurements taken, those relating to the power applied in driving the generators, are probably less reliable than the others, on account of the different methods employed, and the different conditions under which they were taken, with the various machines. With the Siemens' machine a Hefner-Alteneck dynamometer was used, while in the other experiments the power appears to have been determined by indicator cards, taken from the engine driving the generator. The Brush machines also appear to have been driven by a different engine from that used with the others. In this connection we should take into account the fact that the French horse-power used as the unit in these measurements is somewhat smaller than the English horse-power, in terms of which our measurements are usually taken, being represented by 75 kilogramme-metres per second, as against 76 for the English.

The figures given in the table as indicating the effective power applied in driving the generator, appear to be considerably less in the case of the Brush machines, and greater in the case of the Weston machine, than those given by other observers. Mr. Brush has given, as the result of his experiments with his 16-light machine, 15.48 h. p. as the mean applied power with 16 lamps in circuit, while the corresponding figures given by the committee for a similar machine running under almost precisely the same conditions are 13.39 h. p. In view of the fact that the 40-light machine was found to be somewhat less efficient than the 16-light machine, as shown in line 18, under the head of "percentage of applied power converted into electrical energy," we should naturally expect to see in experiment No. 12, at least a proportional increase in the power expended; but this does not appear to be the case. It is to be observed, that there is considerable discrepancy between the results of experiments 12 and 13, both made with the Brush 40-light machine. Although the machine was working under almost precisely the same conditions, as to external resistance, electro-motive force, and strength of current in both cases, and the electrical energy developed was nearly the same, being 24.95 in No. 12, and 24.51 in No. 13, the expenditure of power is given as about one-seventh greater in experiment No. 13 than in experiment No. 12. We are inclined to think that the figures given in No. 13 are more reliable than those given in No. 12; especially as greater care appears to have been taken in making the determinations of applied power in experiment 13.

The figures given in the table for the Weston 10-light machine are 13.01 h. p. In the experiments made with a similar machine at the U. S. Torpedo Station, at Newport, a report of which we publish below, the corresponding figures are given as 9.48 to 9.78 h. p., with ten lamps in circuit, and other experiments have shown still lower figures.

The electrical measurements, and measurements of light are probably much more reliable as data for comparison. The photometric work, especially, appears to have been done with great care, and we are pleased to see that the mean of the illuminating power, in all directions, has been taken as the basis of comparison, as this is obviously the only fair method of indicating the amount of light obtained.

It will be observed that the measurements of light given in the table are extremely low, as compared with the results obtained by other observers; but, as they all appear to have been made with the same instruments, and by the same observers, they may probably be taken with safety as showing the relative results obtained, however unwilling we may be to accept them as indicating absolute values.

Under the head of "electrical calculations" and "results," are given various deductions, calculated from the data obtained by the measurements. We think the committee might, with advantage, have adopted a somewhat different method in comparing results obtained, so as to

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Table of Experiments Made with Continuous-Current Generators and Lamps.

TAKEN FROM THE OFFICIAL REPORT OF THE COMMITTEE APPOINTED AT THE PARIS EXPOSITION.

		Formulae	1 Gramme. 1 lamp	2 Jurgensen. 2 lamps	3 Maxim 1 lamp	4 Siemens. 1 lamp	5 Siemens. 2 lamps	6 Bürgin. 3 lamps	7 Gramme. 3 lamps	8 Gramme. 5 lamps	9 Siemens. 5 lamps	10 Weston. 10 l'mps	11 Brush. 16 l'mps	12 Brush. 40 l'mps	13 Brush. 38 l'mps
	MEASUREMENTS OF POWER.														
1	Speed of generator, revolutions per minute		475	800	1017	737	1330	1535	1695	1496	826	1003	770	700	705
2	Effective power applied—horse-power	T	16.13	21.68	4.07	4.44	5.31	5.32	8.11	8.00	5.05	13.01	13.39	29.96	33.35
	ELECTRICAL MEASUREMENTS.														
3	Resistance of generator in ohms	(r)	0.33	0.45	0.70	0.66	1.68	2.80	0.52	4.57	7.05	1.88	10.55	22.38	22.38
4	Resistance of mains (circuit without lamps) in ohms	(R^m)	0.10	0.82	0.25	0.12	0.13	1.50	1.25	0.62	4.50	1.50	2.56	2.60	7.90
5	Resistance of mains and generator	R	0.43	1.27	0.95	0.78	1.81	4.30	1.77	5.19	11.55	3.38	13.11	24.98	30.28
6	Strength of current in ampéres	I	109.2	90.0	33.0	35.0	26.2	18.5	19.0	15.3	10.0	23.0	10.00	9.5	9.5
7	Fall of potential at each lamp in volts	E	53.0	58.0	53.0	53.0	44.5	41.0	53.0	49.8	47.4	32.0	44.3	44.3	44.3
	ELECTRICAL CALCULATIONS.														
8	Energy appearing in generator and mains	$\frac{RI^2}{75g}$	6.97	13.99	1.41	1.29	1.69	2.00	0.87	1.65	1.57	2.43	1.79	3.07	3.72
9	Energy appearing in one lamp	$\frac{EI}{75g}$	7.87	7.09	2.37	2.52	1.59	1.027	1.369	1.04	0.64	1.00	0.60	0.573	0.573
10	Energy appearing in all the lamps	t'	7.87	6.97	2.31	2.52	3.18	3.08	4.11	5.20	3.20	10.00	9.60	21.88	20.79
11	Total electrical energy	T'	14.84	20.96	3.72	3.81	4.87	5.08	4.98	6.85	4.77	12.43	11.39	24.95	24.51
12	Mean electro-motive force	$nE+RI$	102	172	84	80	136	203	193	328	353	398	840	2009	1971
	MEASUREMENTS OF LIGHT.														
13	Diameter of carbons in millimetres		20	23	12	18	14	13	14	12	10	9 & 10	11	11	11
14	Horizontal illuminating power, each lamp, in carcels		952	607	246	210	142	50	155	112	67	92	37	63	63
15	Maximum illuminating power, each lamp, in carcels		1960	.....	465	805	537	227	357	184	72	154	76	78	78
16	Mean spherical illuminating power, each lamp, in carcels	l	966	688	239	306	205	82	167	102	52	85	38	39	39
17	Total mean spherical illuminating power, all lamps, in carcels	$L=nl$	966	688	239	306	410	246	501	510	260	850	608	1560	1482
	RESULTS.														
18	Percentage of applied power converted into electrical energy	$\frac{T'}{T}$	0.92	0.97	0.91	0.86	0.92	0.95	0.62	0.86	0.94	0.95	0.85	0.83	0.73
19	Percentage of applied power appearing in the arcs	$\frac{t}{T}$	0.43	0.32	0.57	0.57	0.60	0.58	0.51	0.65	0.63	0.77	0.72	0.73	0.62
20	Percentage of total electrical energy appearing in the arcs	$\frac{t}{T'}$	0.53	0.33	0.62	0.66	0.65	0.61	0.83	0.76	0.67	0.80	0.84	0.87	0.85
21	Carcels per horse-power applied to generator	$\frac{L}{T}$	60.0	31.7	58.7	68.9	77.2	46.2	61.8	63.8	51.5	65.3	45.4	52.1	44.4
22	Carcels per horse-power of electrical energy	$\frac{L}{T'}$	65.1	32.8	64.2	80.3	84.2	48.4	100.4	74.5	54.6	68.4	53.4	62.6	60.5
23	Carcels per horse-power of energy appearing in the arcs	$\frac{L}{t}$	128.8	98.7	103.5	121.4	129.3	79.9	121.6	98.1	81.3	85.0	63.3	71.7	71.4
24	Carcels per ampére	$\frac{l}{I}$	8.85	7.64	7.24	8.74	7.82	4.43	8.79	6.67	5.20	3.70	3.80	4.11	4.11

Additional Calculations.

25	Total resistance of entire circuit, (external and internal)	$R^t=\frac{nE+RI}{I}$	.93	1.91	2.55	2.29	5.19	10.97	10.16	21.44	35.30	17.30	84.00	211.47	207.47
26	External resistance, (mains and lamps)	$R^e=R^t-r$	.60	1.46	1.85	1.63	3.51	8.17	9.64	16.87	28.25	15.42	73.45	189.09	185.09
27	Co-efficient of electrical efficiency of generator	$C=\frac{R^e}{R^t}$	.65	.76	.73	.71	.68	.74	.95	.79	.80	.89	.87	.89	.89
28	Net or actual efficiency of generator	$\frac{T'}{T}\times C$	.60	.74	.66	.61	.63	.70	.59	.68	.75	.85	.74	.74	.65
29	Percentage of external resistance in circuit wires	$\frac{R^m}{R^e}$	.17	.56	.14	.07	.04	.18	.13	.04	.16	.10	.03	.01	.04

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show more clearly the comparative efficiency of the different generators, and the comparison would have been still more satisfactory, if care had been taken to subject each system to the same relative conditions when making the measurements.

A system of electric light apparatus comprises three essential elements: The generator, the mains or conductors connecting the generator with the lamps, and the lamps themselves. The resistance of the entire circuit is distributed between these three elements, and the expenditure of the entire amount of electrical energy developed, is apportioned among the elements making up the circuit, in the ratio of their resistances. It is obvious that the resistance of the generator is fixed by its design and construction, and this is also true, within certain narrow limits, in regard to the resistance of the lamp, while, on the other hand, the resistance interposed by the mains or circuit wires, may be varied at will, by varying the size or length of the conductors used.

The true measure of the efficiency of a dynamo machine is, obviously, the proportional part of the entire mechanical energy expended in driving it, which it is capable of converting into electrical energy *and delivering in the external or working circuit.* This depends upon two things; first: The proportional part of the mechanical energy which is converted into electrical energy, and, second: The proportional part of the entire electrical energy developed, which appears in the part of the circuit external to the machine. For the purpose of determining this latter point, it is only necessary to compare the resistance of that part of the circuit external to the machine, with the resistance of the entire circuit, and, for the purposes of this comparison it makes no difference how much of the external resistance is comprised in the lamps, and how much in the circuit wires.

The relative capacities of the different machines, tested for transforming mechanical energy into electrical energy, is shown in line 18. This may properly be called the gross efficiency of the machine. Leaving out of account the Jurgensen machine, which was tested under abnormal conditions, and which, as we have been informed, broke down upon the trial; and also Gramme No. 7, which, as the committee state, was afterward found to be a defective machine, the machines tested, when arranged in the order of their gross efficiency, stand as follows:

GROSS EFFICIENCY OF DYNAMO MACHINES.

Weston	10-lights		.95.
Bürgin	3	"	.95.
Siemens	5	"	.94.
Gramme	1	"	.92.
Siemens	2	"	.92.
Maxim	1	"	.91.
Siemens	1	"	.86.
Gramme	5	"	.86
Brush	16	"	.85.
"	40	"	.83.
"	38	"	.73.

For the purpose of ascertaining the real or net efficiency of the machines, certain additional calculations are necessary, which are readily made from the data given. The total resistance of the circuit, both external and internal, is obtained by dividing the electro-motive force in volts, by the strength of current in ampères, and the resistance of the external circuit, by deducting from the total resistance the internal resistance of the machine. These figures are given in lines 25 and 26, which we have added to the table.

The co-efficient of electrical efficiency of the machine, or the part of the entire current appearing in the working circuit, is readily obtained from these figures, and is given in line 27.

It will be observed that the Gramme No. 7, apparently shows the extremely high co-efficient of electrical efficiency, of .95. This is due to the fact that the machine used was of a peculiar type, termed by M. Gramme *auto-excitatrice.* 'By this term he designated a compound machine, having two armatures on the same shaft, and in the same field, one of which is used only for exciting the field. Of course, what is given as the internal resistance of this machine, is merely the resistance of the main armature, while with the other machines, the resistance given includes both the armature and the field coils.

The net or actual efficiency of the generator is obtained by applying this co-efficient to the figures indicating the gross efficiency, and the results obtained are given in line 28. Arranging the machines in the order of their actual efficiency, as shown by these figures, and again leaving out of account the Jurgensen and Gramme No. 7, they stand as follows:

ACTUAL OR NET EFFICIENCY OF DYNAMO MACHINES.

Weston	10-light		.85.
Siemens	5	"	.75.
Brush	16	"	.74.
"	40	"	.74.
Bürgin	3	"	.70.
Gramme	5	"	.68
Maxim	1	"	.66.
Brush	38	"	.65
Siemens	2	"	.63.
Siemens	1	"	.61.
Gramme	1	"	.60.

These figures are extremely instructive, and will, we think, bear much study. The efficiency of the Weston machine appears to be very much higher than that of any other on the list. This, as will be seen, is due to the fact that not only is the gross efficiency extremely high, but the co-efficient of electrical efficiency is also extremely high. We think it proper to state, that the Weston machine before the committee had the field magnet coils included in the main circuit, and that it is claimed that the Weston machines, of the present type, having the field coils in derived circuit, have a much higher co-efficient of electrical efficiency. This is also true of the Siemens machines.

The Bürgin machine, which appears to have an equal gross efficiency, falls far below the Weston, and other machines on the list, in actual efficiency, on account of its low co-efficient of electrical efficiency, while the Brush machine, which stands at the foot of the list as regards gross efficiency, occupies a respectable position with regard to actual efficiency, on account of its high co-efficient of electrical efficiency.

The co-efficient of electrical efficiency indicates, properly speaking, a more or less effective disposition of the armature and field coils for developing electro-motive force. It would, obviously, be extremely desirable to have no internal resistance whatever in a dynamo machine, as all internal resistance involves, not only absolute waste of energy, but injurious heating of the machine; but this, of course, is impossible. A certain number of convolutions, in the field coils, are necessary for exciting the field magnets, and, in order to secure sufficient length of conductor moving in the magnetic field, to develop the requisite electro-motive force for working the external circuit, there must be a considerable number of convolutions in the armature coils. In both the Weston and the Brush machines, the part of the circuit included in the field coils and the arma-

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ture, appears to have been arranged in an extremely efficient manner for developing the electro-motive force required, while the other machines appear to be far inferior to them in this respect.

The comparatively low actual efficiency of the Brush machine appears to be due, almost entirely, to its extremely low gross efficiency. This is very suggestive, in view of the fact that the Brush machine differs radically from all the other machines before the committee, with respect to the connection of the armature coils with the commutator. In the Brush machine the armature coils are not always in circuit, but each armature coil is, during a part of the revolution of the armature, cut-out of the working circuit and open circuited; while in the other machines the coils are connected in closed circuit in endless series, and are all constantly in circuit. The results obtained by the committee appear to demonstrate conclusively, that this peculiarity of construction of the Brush machine is a radical fault of design, and involves very great waste of energy. The difference in gross efficiency between the two types of machines appears to be so great, that unless compensating advantages of unmistakable value, are secured by the open circuit system of connection with the commutator, machines of this type must, in the long run, labor under a serious disadvantage in competing with machines of the closed circuit type.

It has been claimed, that by cutting out the armature coils during the part of the revolution of the armature when they are comparatively inactive, useless resistance is eliminated from the internal circuit of the machine and a higher co-efficient of electrical efficency is obtained, than is obtainable with the closed circuit or endless series connection. A comparison of the Brush machine with the Weston, however, does not warrant this claim, as the co-efficient of the Weston machine is somewhat higher than the average co-efficient of the three Brush machines; and, as we have already said, we are informed, that this co-efficient has been very greatly increased in the new type of Weston and Siemens machines, having the field coils in derived circuit. Curiously enough, with the commutator connections used in the Brush machine, cutting out armature coils actually increases the internal resistance of the machine instead of diminishing it, as the armature coils are connected with the main circuit in multiple arc instead of in series.

It has also been claimed, with considerable confidence, that machines of the closed circuit type cannot be made to develop as high an electro-motive force as is obtained with machines of the other type. We see no theoretical foundation for such an assumption, but believe, that on the contrary, machines of the closed circuit type will be found more efficient in this respect also. Obviously, other things being equal, higher electro-motive force is developed by all the armature coils, acting in conjunction, than by a part of them, and we can see no advantages to be gained, in respect of electro-motive force, by cutting out a part of the armature coils from the circuit, even when they are not in the strongest part of the field.

Referring now to line 19 of the table, "percentage of applied power appearing in the arcs," the figures given, indicate the proportional part of the entire mechanical energy expended, which appears as useful work in the arcs. In these figures the resistance of the entire system has to be taken into account; the resistance of the generator, the resistance of the circuit wires, and the resistance of the lamps themselves. As we have already said, the results would have been more instructive, had the different machines and lamps been used under the same conditions—that is, with the circuit wires forming the same proportional part of the entire external resistance. In line 29 of the table, we have calculated the percentage of external resistance represented by the circuit wires, taking the different systems as they were used by the committee, and we find that it varies from one per cent. in the case of experiment No. 12, to 18 per cent. in experiment No. 6, (leaving out of account the Jurgensen machine, which, as we have said, was used under entirely abnormal conditions); that is, the Brush 40-light machine in experiment No. 12, was used under the most favorable conditions of all, while the Bürgin machine was used under the least favorable. Without, however, taking these differences into account, the results shown in the table stand as follows:

PERCENTAGE OF APPLIED POWER APPEARING AS USEFUL WORK IN THE ARCS.

Weston	10	light	.77.
Brush	40	"	.73.
"	16	"	.72.
Gramme	5	"	.65.
Siemens	5	"	.63.
Brush	38	"	.62.
Siemens	2	"	.60.
Bürgin	3	"	.58.
Maxim	1	"	.57.
Siemens	1	"	.57.
Gramme	1	"	.43.

Referring now to line 20, "percentage of total electrical energy appearing in the arcs," the efficiency of the machine is eilminated, and the figures given, indicate merely the relative resistance of the lamps to the resistance of the rest of the circuit, including the internal resistance of the machine, and the resistance of the circuit wires. In this, owing to the relatively low resistance of the circuit wires, the Brush stands at the head, and the different systems are arranged in the following order:

Brush	40	light	.87.
"	38	"	.85.
"	16	"	.84.
Weston	10	"	.80.
Gramme	5	"	.76.
Siemens	5	"	.67.
"	1	"	.66.
"	2	"	.65.
Maxim	1	"	.62.
Bürgin	3	"	.61.
Gramme	1	"	.53.

By reference to the preceding line, however, it will be seen that although the resistance of the circuit wires used with the Weston machine was ten per cent. of the entire external resistance, and the resistance of the mains used with the Brush machine, in experiment No. 12, was only one per cent., yet, the actual efficiency of the entire system was considerably higher in the case of Weston, on account of the greater efficiency of the generator.

Line 20 is principally useful, as showing the great desirability of keeping down, as far as possible, the relative resistance of the mains; and it is obvious, that those systems working a comparatively long arc, and in which the resistance of the lamps is consequently relatively high, have the advantage of involving less waste of current energy in the mains with a given size of conductor. In this connection, we may properly consider line 24, which shows the number of carcels per ampère of current. This, as will be seen, has no discoverable relation to the efficiency, either of the machines or lamps, but appears to depend principally upon the comparative length of the arc used. It varies from 8.85 in Gramme 1-light, to 3.70 in Weston 10-light. We regret that the report does not give the length of arc used in each lamp.

Line 21, "carcels per horse-power applied to generator," probably contains the information most interesting to

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the public generally, as it shows the comparative results in light, produced for each horse-power expended in driving the machine. The systems, arranged in the order of their efficiency, stand as follows:

CARCELS PER HORSE-POWER APPLIED.

Siemens	2	light	77.2.
"	1	"	68.9.
Weston	10	"	65.3.
Gramme	5	"	63 8.
"	1	"	60.
Maxim	1	"	58.7.
Brush	40	"	52.1.
Siemens	5	"	51.5.
Bürgin	3	"	46.2.
Brush	16	"	45.4.
"	38	"	44.4.

These results are not strictly comparable with each other, on account of the differences in relative resistances of the mains used, to which we have already alluded, and on account of the great difference in the amount of light given by each lamp in the different systems. If, for instance, the mains used, had in each case been made equivalent in resistance, to one per cent. of the total external resistance, as in the case of the Brush 40-light, the results obtained with the other systems would have been considerably increased.

We do not consider these results as indicating an absolute measure of value of the systems, as it is obvious, that the Siemens machines for producing one or two lights of the large size used in the experiments. would not be capable of the wide industrial application, which the Brush and Weston systems have received.

Line 22, "carcels per horse-power of electrical energy," does not vary greatly in its relative results from the preceding line. It is noticeable, however, that here the relative resistance of the mains plays a more important part.

In line 23, "carcels per horse-power of energy appearing in the arc," the efficiency of the generator, and the resistance of the mains, are both eliminated, and the figures indicate the relative efficiency of the lamps, as instruments, for converting current energy into light. Here Gramme No. 1 should be disregarded, the lamp used was regulated by hand, while Jurgensen and Gramme No. 7 should properly be included, as defects in the generator do not affect the result. It is stated that a Serrin lamp was used with the Jurgensen machine, and Crompton lamps with the Bürgin machine.

Arranging the lamps in the order of their apparent efficiency, they stand as follows:

RELATIVE EFFICIENCY OF LAMPS.

	Number of lamps.	*Carcels in each lamp.*	*Carcels per arc horse-power.*
Siemens	2	205	129.3
Gramme	3	167	121.6
Siemens	1	306	121 4
Maxim	1	239	103.5
Serrin	1	688	98 7
Gramme	5	102	98 1
Weston	10	85	85.0
Siemens	5	52	81.3
Crompton	3	82	79.9
Brush	40	39	71.7
"	38	39	71.4
"	16	38	63 3

This cannot, properly, be regarded as an accurate comparison of efficiency of the different lamps, since, as the committee point out in their report, the amount of light produced by a given expenditure of power, undoubtedly increases, very considerably, with the amount of light produced in each lamp. Nor, would it be fair to compare single lamps with lamps constructed for working in series.

We have already spoken of the extremely low photometric results reached by the committee. Taking the value of the carcel as 9.5 candles, it will be observed that, with the principal series systems, no results were obtained as high as 1000 candles per horse-power, and, even at the maximum illuminating power which was obtained by throwing the carbons out of line, and taking the measurements on the maximum side, none of the lamps show an illuminating power of 2000 candles each.

SERIES SYSTEMS.

Candles, per lamp and candles per horse-power.

	Number of lamps.	*Maximum each lamp.*	*Mean each lamp.*	*Candles per horse-power.*
Weston	10	1463.	807.5	620.35
Gramme	5	1748.	969.	606.10
Brush	40	741.	370.5	494 95
Siemens	5	684.	494.	489.25
Brush.	16	722.	361.	431.30
"	38	741.	370.5	421.80

The results obtained by Professors Ayrton and Perry, are very much higher—as will be seen by the following table, which we reproduce from the *Engineer*, omitting such parts as do not relate to arc lamps.

AYRTON & PERRY'S EXPERIMENTS WITH ARC LAMPS.

Name.	*Electro-motive force in volts between the two terminals of lamp.*	*Current in Ampère's flowing through lamp.*	*Horse-power expended in the lamp.*	*Candle Power.*		*Candles per horse-power.*		*Mean candles per horse-power.*
				Green.	*Red.*	*Green.*	*Red.*	
Crompton	37.7	25	1.26	2916	1849	2314	1467	1890
Pilsen	86.8	10·33	0. 8	780	512	1625	1066	1345
Brush	88	10	0.71	2025	961	3970	1884	2927
Sautier-Lemonnier. One lamp on "A" Gramme machine.	40	43	2.3	15376	5625	6685	5446	4565
Ditto.	45	42	2.51	15376	9025	6054	3553	4803
Sautier-Lemonnier. One of ten lamps on H. Gramme Machine	40	12.5	0.67	540	310	806	463	634
Ditto.	40	12.5	0.67	*784	125	1170	187	678
Gravier	46.6	9.2	0.58	1023	349	1173	691	1189
Serrin	31.1	37.3	1.49	2448	938	1616	630	1123
Cance	51.8	16.7	1.16	3445	1156	2970	997	1983
Weston	33.7	21.7	0.98	2663	1024	2717	1045	1881

It should be borne in mind, that Professors Ayrton and Perry made no measurements, or tests, of the generator used in producing the current, but confined their attention to the lamp taken by itself. What they have published is, in no sense, an official report, but is in the form of a paper contributed to our contemporary *The Engineer*. Its authors do not appear to have been afforded such facilities as would be essential for thorough work, and they do not appear to be satisfied themselves with the results obtained. They say: "When measuring the strength of the lights at Paris, we were not able to extend our experiments on each lamp over a sufficient length of time to obtain an average result, independent of fluctuations of the light, due to the adjustment of the lamp not being the best for the particular strength of

* This measurement of light was made on Rumford's method.

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current passing through it * * * * * Finally, therefore, we may conclude, that to measure the efficiency of any special electric lamp, or number of candles it can give per horse-power, expended in it, requires that a very considerable number of experiments should be made on that one lamp, burning apparently under constant conditions, in order to eliminate atmospheric absorption and irregularities of burning, which are not accompanied by variations in the amount of horse-power spent in the lamp."

The evident inconsistencies of the results obtained, would seem to justify the lack of confidence expressed by Profs. Ayrton and Perry in the accuracy of their work. These inconsistencies are, we are confident, entirely due to lack of facilities for making proper tests, as they are certainly not in any degree due to lack of ability on the part of the observers; and the part of their paper relating to experiments made with incandescent lamps, at London, appears to contain much valuable information.

Our contemporary, *The Telegraphic Journal*, has very justly pointed out various striking inconsistencies in the results obtained, at Paris, with arc lamps. As, for instance, referring to the performances of the Brush and Pilsen lamps,—"measurement between the terminals of these two lamps gave the following results:—electro-motive force in volts: Brush 38, Pilsen 37; current in ampères flowing through the lamp: Brush 10, Pilsen 10.3; horse-power expended in lamp: Brush .51, Pilsen .48. It will be seen that for all practicable purposes the electrical conditions of the two systems were identical, and of course the resistance between terminals must have been practically the same, and one would expect that the lights produced would also be equal; but we are told that observations, through a green glass, gave, Brush 2,025 candles, the Pilsen only 780; through a red glass, Brush 961 candles, the Pilsen 512; and that the candles per horse-power expended in the lamps = Brush, observed through green glass, 3,970 candles, through red glass, 1,884, the mean result being 2,427 candles; whilst the Pilsen lamp gave, when observations were taken through green glass, 1,625 candles, through red, 1,066, the mean result being 1,345 candles, or a little more than half that of Brush. * * * * Take another instance, the Crompton system; we are not aware that this lamp has any considerable resistance, independent of that in the arc itself, to absorb any large part of the current passing, yet, with the same electro-motive force as the two before mentioned lamps, and a current of 25 ampères flowing 2½ times more quantity than either the Brush or Pilsen, and absorbing 1.26 horse-power in the lamp, we only get a candle power per horse-power of 1890, or about three quarters that of Brush.

"A still more astonishing result is shown in measuring the Sautier-Lemonnier lamp, the electro-motive force is given as 40 volts (a trifle more than was shown in the Brush), the current in ampères 12.5, the above remark applying to this also, and the horse-power absorbed in the lamp .67, yet this lamp only gives a mean result for horse-power of 634 candles."

Other similar inconsistencies occur in the table, and these we must attribute either to defects in the instruments or errors in the observations, or to a difference in the adjustment or condition of the lamp when the measurement of the light was made. It is obvious, for instance, that if the carbons in two lamps were out of line so as to turn the greater part of the light in one direction, and the photometric observation was made in one case on the maximum side, and in the other on the minimum side, the apparent difference would be very great, while the mean difference might be extremely small. We think that the figures given cannot safely be taken, even as a basis of comparison of the different lamps, but we must consider them as entirely misleading, except perhaps, as showing that the photometric observations of the Paris committee were, as a whole, quite low.

This is also indicated by the following table which is taken from the Proceedings of the Naval Institute, of April 14, 1882, and shows the results of experiments made at the U. S. Torpedo Station, at Newport, with Brush and Weston machines:

EXPERIMENTS MADE AT THE U. S. TORPEDO STATION, NEWPORT, WITH BRUSH AND WESTON MACHINES.

Weston 10 light machine.								Brush No. 5 machine wound for 3 lights.				
9.781	9.945	10.83	9.46	9.56	9.59	6.8	6.596	5.52	4.06	4.67	4.96	*Horse-power applied to generator.*
935	935	935	930	922	930	700	690	656	615	615	635	*Revolutions.*
17.98	18.27	19.89	17.65	17.73	18.41	18.61	18.45	29.25	28.72	24.31	25.90	*Ampères.*
2.15	2.15	2.15	2.13	2.13	2.15	2.13	2.11	1.35	1.35	1.35	1.35	*Internal Resistance.*
15.00	14.76	13.70	14.67	14.53	13.51	8.39	8.30 (all arcs.)	1.48	1.56	1.50	1.57	*Resistance of 1 arc.*
10	9	8	10	9	8	7	7	2	2	2	2	*No. of arcs.*
18.45	18.13	16.99	18.10	17.88	16.90	11.88	11.49	4.90	5.06	4.74	4.96	*Total Resistance.*
7.958	8.112	8.567	7.557	7.54	7.638	5.872	5.948	3.55	3.81	3.75	4.84	*Horse-power in circuit.*
6.456	6.594	6.900	6.124	6.138	6.138	3.89	3.796	2.15	2.25	2.38	2.60	*Horse-power in arcs.*
1917	1796	2100	1935	1710	1995	1700	1548	2039	2186	2216	2213	*Candles in 1 arc.*
1244	1625	1688	1800	1610	1660	1750	1642	746	883	910	892	*Candles per horse-power applied.*
								1915	1980	1962	1850	*Candles per horse-power in arcs.*
81.4	81.5	88.9	79.7	78.9	79.6	79.0	79.5	64.8	77.0	77.0	87.4	*Gross efficiency* = *H. P. in circuit* / *H. P. applied.*
66.0	66.8	68.8	64.6	64.2	64.0	57.2	57.4	39.	47.5	49.9	56.5	*Net efficiency* = *H. P. in arcs* / *H. P. applied.*

It is to be regretted that more complete data are not given, and the comparison would have been more satisfactory if a Brush machine of larger size had been used.

The measurements of light, it will be observed, are very much higher than those of the Paris committee, while the measurements of power applied to the Weston machine are considerably lower.

With such methods, as are at present available for measuring power and light, great discrepancies between the results obtained by different observers seem to be unavoidable; and the only way in which we can hope to obtain a fair comparison of the different systems is to submit them to the same observers, and have the different measurements taken as nearly as possible under the same conditions and with the same instruments. Much progress has been made since the Paris Exposition; and it would be of great advantage to all interested in the development of the electric light, if the principal systems, now before the public, could be submitted to an exhaustive series of tests, in the way we have indicated, by competent scientific men, who would command the confidence both of the manufacturers and of the users of the apparatus. We hope that the different electric light companies will see that it is for their advantage to institute such a series of tests at an early day.

—— THE OLD ARM CHAIR is what they sing about, but for business, give us the new arm chair, the latest invention for tame bores. It is so arranged, that when it is considered that our chronic office visitor has sat long enough, a foot switch, in another part of the room, can throw currents to various parts of the chair, at harmless looking upholstery buttons and gimp tacks, so that the twinges which our friend receives will incline him to the belief that he had better go home, before he is too sick to be carried there. For extreme cases a battery of Leyden jars can be provided.

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THE INVENTOR A FACTOR OF CIVILIZATION.

ONE of the features of modern civilization is expressed in the desires of each individual, to an extent far beyond the limit of his physical powers, to furnish those requirements: a greater amount of work, than the combined efforts of the workers in the community being necessary to fulfil our demands for support, and also the desires for accumulation, which is but another expression of the instinct of self-preservation.

The wants of the barbarian are supplied by occasional efforts, his labor is irregular and subsistence meagre; with the rising scale of civilization, the amount of labor, essential to a comfortable existence, increases in a corresponding manner. To satisfy the demands of the more highly civilized communities, the elements are made tributary to man; conquering nature with the forces which itself furnishes.

In commercial affairs, the capitalist and the manager are weak indeed, unless seconded by the inventor to complete the trinity of affairs. The creations of the inventor are acceptable only to the extent that they fill a demand, although it is true that at this day, a demand is frequently developed by skilful business management.

Many of the properties of steam were known before the Christian era, and the modern type of steam engine dates from Newcomen in 1705; yet, it was over half a century later, when the requirement for pumps, equal to the problem of the increasing depth of the English mines, gave ample scope to the mind of James Watt. Born a century earlier, Watt might have been an excellent instrument maker; had fate deprived the earth of his presence until a century later, there would have been opportunities for his resources in other directions; but the steam engine would already have been developed at the time when it was essential to the world's progress.

In our day, the problem of steam navigation has shown a remarkable development. Higher steam pressures, and increased engine speed, have reduced weight of machinery, and consumption of fuel, with its additional economy of diminished space; and also the changes in the ship's lines, have resulted in such economy that every pound of coal now conveys thirty-five times as much cargo across the Atlantic, as in the earlier days of the steam lines.

Everywhere, in demanding an increase in the amount of work, civilization requires that expenses should be relatively dimished. The railway statistics prove, by the logic of figures, that the increase in traffic, necessary to meet the requirements of inland commerce, have been accompanied by a modification in rates. This has been possible by the work of invention in every part of the railway system.

Stephenson's work on the locomotive was possible, only because cheaper and more rapid transportation of passengers and merchandise were of great importance. The demand for economy of time, rendered the telegraph and telephone commercial possibilities, and they in turn have readjusted systems of finance and methods of business. Electricity has its uses in every transaction and place in civilized life.

In the applied sciences, connected with all instruments of precision, electricity is essential to obtain the most correct results. The indications of the weather, and the uniform distribution of correct time, are examples of its use in popular science. The watchmen's clock supplies the faithful guardian of property with an unimpeachable record of duty performed. The dials of some of these ever vigilant devices, bear the motto: *custos ipsos custodios*, an expression which, like law, bears hard only upon offenders.

In some lines of manufacture, notably electro-plating, electricity has superseded other methods and processes. The results with electric lights in mills, have been so favorable that it may be considered essential to the best results in manufacturing during night work.

In the fire alarm, electricity forms a stalwart defender against the ravages of fire, its timely warnings summon the fire department with such promptness, that builders rear their piles of combustible construction in defiance of the chances of conflagration.

In our homes, the simplest electrical devices form conveniences which add much to comfort. Let us recount a few of these contrivances which are regularly made for the market, and not merely the toys of ingenious youth. The foot fall on the door mat, or the porch step, announces an arrival before the comer can touch the electric door bell. Servants are called at will with annunciators, or in combination with a clock, summoned at pre-determined times.

A pull on a tassel hanging from the chandelier, lights the gas, to the exclusion of the baneful friction match.

When the temperature departs from a selected range, a ringing bell gives notice of the fact. When the burglar begins his trespass, it sounds an alarm for the household and the police, and also turns on and lights the gas, to the discomfiture of those "who prefer darkness rather than light, because their deeds are evil."

The mechanical problem of the coming age, will be to accomplish the economical transfer, concentration, and possibly, storage of energy. The first two are essential, and the third is of great and perhaps equal importance. The limits of the use of steam are so well defined that it is probable that either electricity, or fuel gas will be the means by which small powers can be produced, with an economy approaching that of large centres of power. Practical difficulties still surround the gas engine, and the electro-motor, especially in matters relating to accuracy, and economy in regulating speed, although gas engines are quite successful in some places, even when supplied by the more expensive illuminating gas. We anticipate that the gas engine will, eventually, prove one of the most efficient allies to the electric lighting interests.

In citing a few of the many instances of the uses, and expectations of electricity, we wish to call attention to the increasing extent of the field for the employment of electricity; as it furnishes a principle which is a guardian that never sleeps, a messenger that never wearies, a light that vies with the noon-day sun, and embodies the most economical method of transmitting power.

The civilization of to-day, looks to the inventor for perfecting many an immature device, as well as for solving the problems which beset the path of improvement.

ATTENTION was called in these columns, some time ago, to the very satisfactory dividends, paid by the solid and enterprising electric companies, in England. We are glad to see that such companies are also proving very remunerative, in this country.

While some undertakings without any solid basis, financial or industrial, will assuredly come to grief, there is no doubt that electricity will continue to afford an almost limitless field for capital, and a paying investment for many years to come. It has some peculiar advantages: The most rapid transmitter of human thought; it can be used for automatic purposes to a magic extent; annihilating space; marking time to the second. It is also a transmitter of force, and will be used as the great distributor of power, in ways that are not dreamed of yet. It is also the illuminating agent of the future. It is, finally, susceptible of developments, and services, which are, as yet, in the womb of time. Capital has not turned to it yet, as much as was expected, but the probabilities are, that it will soon be largely attracted by it.

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THE NEW YORK ELECTRICAL SOCIETY—PROF. MAYER'S LECTURE.

ON Friday, January 12th, the Society met at the Stevens Institute of Technology, in Hoboken, N. J., to hear a lecture by Professor Alfred M. Mayer, who has for many years occupied the Chair of Physics at the Institute. The Professor's great reputation as a teacher, and the knowledge that he would have at his disposal all the resources of one of the finest laboratories for physical research in the country, attracted a large and more than ordinarily intelligent audience, in spite of the exceedingly inclement weather, and the delays consequent upon the ice blockade in the North and East rivers.

The lecture, which was listened to with the closest attention, was an experimental demonstration of the laws of Ohm, and was a complete success in every respect, affording numerous illustrations of the Professor's marvellous delicacy and accuracy of manipulation in experiments, as well as his thorough acquaintance with the general principles underlying the demonstration.

The lecturer proposed to demonstrate to the audience, experimentally, the truth of Ohm's well-known law, which is the foundation of all intelligent applications of electricity, viz.: that the quantity of electricity in any circuit is equal to the electro-motive force, divided by the resistance; or, as it is frequently stated, more concisely, $C = \frac{E}{R}$

The Professor used, for the demonstration, a Thomson reflecting galvanometer, whose coils, together with the connecting wires, had a total resistance of one ohm. A scale of 60 divisions, 30 on each side of zero, and having every five divisions marked in figures, was used to show the deflection of the spot of light reflected from the needle of the galvanometer. A powerful calcium light was used to produce the ray which was to be reflected from the needle.

The Professor first described the proper way to set up the galvanometer. He first found the magnetic meridian, by the aid of a long, horizontal magnetic needle, and drew a line on the table at right angles to the meridian. He then placed the coils of the galvanometer on this line, their longest axis being, therefore, at right angles to the meridian. He drew a line from the centre of the needle, in the magnetic meridian, to the scale, so that the scale was bisected by the plane of the meridian, at the zero mark, and the scale itself was, therefore, in a plane at right angles to the magnetic meridian, and parallel to the plane of the coils.

The galvanometer needle had hitherto prevented from swinging by the inductive action of the damper magnet, which was now removed, and the needle moved freely into the magnetic meridian. The lecturer then carefully adjusted the fibre of unspun silk, by which the needle was suspended, and showed that the needle had no bias in either direction, and was, therefore, free to obey any impulse given by a current in the coils; and, on adjusting the damper magnet, the spot of light remained motionless on the zero of the scale. The damper magnet also prevents too frequent oscillations of the needle, after it has been moved from its position of rest by a current.

The learned Professor then produced a permanent bar magnet, fixed in a vertical position on a stand, and having a wooden flange around it at the neutral point, so that coils of wire could readily be placed on and around the bar (as one slips a ring on the finger of one's hand), and as readily withdrawn. He then exhibited five coils of copper wire, the first consisting of one turn or circle, only; the second, of two turns; the third, of three; the fourth, of four; and the fifth, of five turns, the total resistance of each, added to that of the galvanometer spools and connections, was one ohm. The lecturer explained that the galvanometer was a tangential one, in which the deflection of the needle was always in proportion to the strength of the current producing the deflection.

The speaker then placed the single coil of copper wire in connection with the two terminals of the galvanometer coils, thus forming a simple closed metallic circuit, consisting of the galvanometer coils, the connecting wires, and the single ring of copper wire. This ring he placed on and around the bar magnet, and waited until the needle had settled from the oscillations thus produced, when he suddenly and rapidly drew the ring off the bar magnet, causing the ring to cut the "lines of force" emanating from the magnet, at right angles, their direction. Instantly, the needle of the galvanometer was deflected by the magneto-electric current so induced in the coil, and the spot of light moved to 4° on the scale. The same movements were then repeated with the other coils, in succession, and it was thus shown that the coil with two turns, by which the "lines of force" were cut twice as often as with one coil, produced a deflection of 8°; the coil of three turns produced a deflection of 12°, or three times as much as the coil with one turn; and so on, up to the coil with five turns, which produced a deflection of 20°.

The law of Ohm was thus demonstrated in one of its aspects, viz.: that, when the resistance in circuit remains unchanged, the quantity of current in any given circuit increases and decreases in the same ratio as the electro-motive force varies.

The Professor then varied the conditions of the experiment by taking four resistance coils of copper wire, of different sizes. The first coil having one ohm resistance; the second coil had twice as much resistance as the first; the third, three times as much; and the fourth, four ohms. The resistance coils were now successively connected in the circuit of the galvanometer coils and generating ring of five turns of wire, encircling the bar magnet; the latter remaining unchanged throughout this part of the experiment, consequently the electro-motive force remained unchanged. The first and smallest resistance coil being placed in circuit making the tatal resistance in circuit two ohms, and the generating coil being rapidly withdrawn from the magnet, a deflection of 10° was produced. The removal of the first resistance coil and insertion of the second making the total resistance in circuit 3 ohms, and subsequent operation of the generating coil, allowed a deflection of $6\frac{66}{100}$ (or one-third of twenty) 20°; while the same proceeding with the third resistance coil making 4 ohms in circuit gave only a deflection of 5° (or one quarter of twenty); and on adding the largest coil, making the total resistance five ohms the deflection was brought down to 4° (or one-fifth of twenty.)

This demonstrated the truth of the second aspect of Ohm's law, which is the converse of the first, viz.: that, when the electro-motive force in any given circuit remains unchanged, the quantity of current varies in the same ratio as the resistance in the circuit varies, increasing and diminishing with it.

Thus, the truth of the law, which has so long been unquestioningly accepted as an axiom by all electricians, was demonstrated in a manner equally convincing to the expert electrician as to the uninstructed beginner in the science, and so skilfully performed as to challenge the admiration of the most critical observer.

A hearty vote of thanks to the learned Professor, for his great labor in preparing the apparatus, as well as for his instructive lecture, terminated the proceedings.

After the lecture the audience inspected the apparatus in the laboratory, among which was an ingenious adaptation

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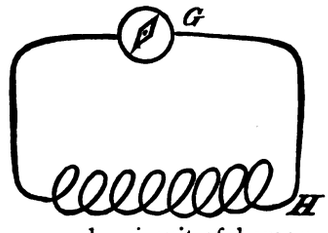
of the above described apparatus, to the study of the variation in the magnetism of iron produced by variations in the strength of the current of electricity within the coil.

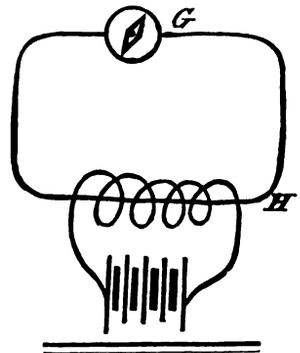
AN IMPORTANT DISCOVERY.

PROF. A. E. Dolbear, of Tuft's College, near Boston, has made an important discovery, proving that magnetism consists of a molecular change.

It is well known, if a galvanometer be placed between the terminals of a circuit of homogeneous iron wire, and heat be applied, no electrical effect will be observed ; but if the structure of the iron is altered by alternate bending, or twisting to a helix, as shown in the sketch, and heat applied at H, then the galvanometer G will indicate the presence of an electrical current in the wire.



The professor used a circuit of homogeneous iron wire, and the application of heat at H produced no electrical current in the wire. A portion of the wire was surrounded by a helix, and connected with a battery ; the current in these wires, of course, magnetized the circuit wire where it was surrounded by the helix ; under these circumstances, the galvanometer at G showed the presence of electricity in the main circuit; as it is well known, that upon the application of heat to a circuit of un-homogeneous material, a current is produced ; and this experiment showed, that a current was produced in the circuit, only when a portion was magnetized. These experiments prove, that magnetism must be connected with some molecular change of the metal magnetized.



—— ON THE 18th of January, Mr. Arthur Schofield, an aged gentleman of means, was found dead in his bed, at the St. Stephen's Hotel in this city. The room was filled with gas, the old gentleman having, turned it on, and evidently forgotten to light it.

—— IN THE SUIT OF Catharine Vincent against the city of Brooklyn for damages, for the loss of the life of her son, Oliver S. Vincent, a clerk, who was killed by a gas explosion in the vault of the Tax Office in the Municipal Building, the jury, on the 18th of January, gave her a verdict for $5,000, the full amount claimed.

—— A PATENT HAS been taken at Görlitz, Germany, for an invention which will make it difficult for burglars to escape detection. In the neighborhood of a safe an apparatus is placed, which on being touched immediately starts an electric light, and at the same time uncovers a prepared plate, on which the burglar's photograph is taken while an alarm is sounded.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from page 10.*)

THE MANHATTAN INSTRUMENTS.

FOR the transmission of general news despatches, on the long up-town and surburban lines, as well as for the distribution of Kiernan's financial news to his subscribers—a service which is undertaken by this company—an instrument bearing the above name is used. It was invented by Mr. J. E. Smith, and first manufactured by the late Charles T. Chester, and was introduced by a competing company called the Manhattan Quotation Company, from whence it derives its name. After the consolidation of the Manhattan Quotation Company with the Gold and Stock Telegraph Company, the managers of the latter determined to avail themselves of the good qualities of the instrument which the fortune of war had placed in their hands ; and machines were at once put into use for the general news service, and subsequently, after their immense superiority to the machines then in use had been demonstrated, more were constructed and placed on Kiernan's *financial news* circuits There are now in use, in New York City and suburbs, over 400 of these instruments.

In describing these machines, it will be found conducive to an easy grasp of the details, if the receiving machine should be described first, and the transmitter afterward, and that arrangement will therefore be adopted.

In studying this instrument we meet at once different principles of design and construction to those of the three wire instruments already described. This instrument has but one wire, in place of three ; all the characters of its alphabet are placed on the periphery of one single type wheel ; the letters and figures are printed in one line on the paper ; and what is the most important difference, and also the foundation of its great superiority in speed, is the fact that the motive power which drives the type wheel, is a spring or weight in the receiving instrument itself. In the three-wire machine, first described, the main line current drives the type wheel; while in this machine the current only controls the movements of an escapement anchor which releases the type wheel. As electricity is at once a subtle and costly agent, it follows that it will be cheaper and better to restrict its field of operation as much as possible. Although the introduction of machine currents on stock reporting lines, and the consequent cheaper and more abundant supply of electricity to be thereby afforded, the difference in value between the two classes of machines will be lessened, yet there will always be a margin of superiority in respect of higher speed, less wear of the parts, and greater accuracy in working, in favor of the latter class.

As has been stated, this machine was invented expressly as a competitor to the instrument first described, and it would be difficult to imagine a machine simpler, faster, more reliable, or better adapted to the work for which it was designed. It will always remain, even when superseded by the more rapid machines which increasing business demands, a monument to the inventive skill and good judgment of its inventor. The machine consists of the following parts :

First, two electro-magnets held by a frame opposite each other, having their poles in the same horizontal plane, and a polarized armature, pivoted so as to be free to vibrate between the poles of the electro-magnets. These magnets are 1½ inches long, have a resistance of 3 ohms each, and are called the *escapement magnets.*

Second, an electro-magnet of 6 ohms resistance, and 2 inches long, acting on a neutral armature attached to a

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lever which operates the printing, feeding, and unison tripping mechanism. This is called the *press magnet.*

Third, a train of clock work, driven by a weight or spring, turning a shaft to which is rigidly attached the type wheel and the escape wheel. The unison is also operated by the train in a manner which will be described later. The teeth of the escape wheel engage against the pallets of an anchor, which forms the lower prolongation of the polarized escapement armature, above described. The escape wheel teeth and anchor pallets, are so shaped as to form a "dead beat" escapement; that is to say, the whole train stops and the weight ceases to fall while the wheel is held by the anchor, and starts again when that tooth is released, and so on *ad infinitum.* When the polarized armature is vibrated from side to side, by the action of the current, the escape wheel is allowed to revolve, step by step, being impelled by the weight or spring acting through the train, and in this manner the type wheel is revolved to the proper position, and held there while the operation of printing the letter takes place.

All three of the magnets, viz., the press magnet and the two escapement magnets, are in the circuit of the same line wire. The currents, therefore, pass through all three magnets simultaneously, but not in the same direction. The direction of the current through the press magnet is of no consequence, as it has a soft iron armature, but it must pass through the escapement magnets in such a way that the polarized armature will be attracted by one of the magnets at the same time that it is repelled by the other, and *vice versa*, otherwise it would not move at all. The transmitter sends into the line rapidly alternating positive and negative currents, and these in passing through the escapement magnets, vibrate the polarized escapement armature from side to side. When moved to the extreme limit of its excursion on the left hand side, the pallet of the anchor, which is attached to the armature, is moved just far enough to allow a tooth of the escape wheel to slip by it, on the right hand side, while at the same time the left hand pallet slips into the space ahead of the next tooth and locks the wheel, so that it can only move forward one tooth, or step, at a time. The reverse action takes place with a current of the opposite polarity Now, after a sufficient number of waves of alternate polarity have been sent into the line, to rotate the type wheels to the position for printing the desired letter or figure, the last wave of current is prolonged, at the will of the operator (as long as he holds the key of the transmitter down), and the printing then takes place.

It now remains to trace out the action of these currents on the press magnet, and to explain the method by which the printing and feeding mechanism is actuated. All of the rapid waves of alternate polarity pass through the press magnet, and are all equally potent to affect its neutral soft iron armature, but the latter is provided with a powerful retractile spring, which, together with the weight of the printing lever and its accessories, constitute a load too heavy for the feeble magnetism generated by rapid waves of electricity to overcome. However, the retracting spring may be slackened so that the press magnet armature will be attracted by every pulsation passing through the press magnet, and then every letter on the type wheel will be printed in succession. The spring is made a little stiffer than is necessary to prevent this action, and then no letters are printed until the type wheel stops, and the vibrations cease, the last one being prolonged. There are three ways in which the margin of adjustment between printing every letter in succession (called technically "throwing in letters"), and printing only the desired letters when the type wheel is stopped, may be varied. First, by varying the strength of the current or the resistance in the main line; second, by varying the speed of the vibrations; and third, by varying the tension of the retractile spring or any weight on the press lever. It is obvious that the latter is the only convenient practical method. When the machines were first used, vibrating relays were arranged to cut out the escapement magnets when the type wheel stopped, thus suddenly increasing the quantity of current in the printing magnets, but the device was found to be unnecessary, and the instruments were subsequently constructed without them, as herein described.

The type wheel, which is rigidly fixed to the same shaft as the escape wheel, contains 40 characters, and is so adjusted in relation to the escape wheel, that a movement of one tooth of the latter moves the type wheel forward one letter; so that 40 emissions of the current are required to rotate the type wheel once.. The type wheels usually run at the rate of 64 revolutions per minute, requiring 2,560 pulsations per minute, or 42.66 pulsations per second. A speed of 17 English words per minute, or an average of 14 stock quotations per minute, is thus attained by a skillful operator. The characters on the type wheel are especially arranged with a view to securing the printing of the name of a stock, the number of shares sold, the price and conditions of sale, all in one revolution of the type wheel; or at least, in as few revolutions as possible, and this feature is the subject of a separate patent. It is obvious that, in a step-by-step machine used for printing stock quotations, this feature will have a very marked effect upon the average speed of the machine, and in order to illustrate that point, we give herewith the characters and the order in which they appear on the wheel. A blank space, used for separating words, precedes the colon. The reader can trace for himself the consecutive letters and figures that can be used in combination, in one, or say two revolutions of the type wheel:

: VCBHPADMXRZKELNTQWUFGJSY. 1987536/42801

The printing mechanism consists of a revolving soft rubber pad, over which the paper is carried, which presses the paper against the type wheel whenever the armature of the press magnet is attracted. An adjustable limit, against which the press lever strikes, varies the force of the impact of the pad against the type wheel, and the consequent distinctness of the impression made by the types upon the paper. Fixed on the same shaft with the rotary pad is a feed wheel, with very fine teeth on its edge, and a feed ratchet, with very coarse teeth, and these three all revolve together. A pivoted hard rubber disc, called the pressure roller, is held by a projecting arm attached to the press lever, over the paper, and holds the latter down on the sharp teeth of the feed wheel, so that when the latter revolves the paper revolves with it. When the pad is moved upward, a feed dog, rigidly fixed to the frame of the machine, first slips over one of the passing teeth of the feed ratchet and then drops under it. When the press lever falls this dog retains its clutch on the tooth in the feed wheel, and it is obvious that the latter must revolve, since the former cannot move upward or downward. Another pawl, called the lower or under feed dog, which is simply a straight piece of steel spring, fastened to the frame of the machine, falls between the teeth of the feed ratchet on the opposite side to the upper dog, and catches on the flat side of the teeth, so as to prevent a backward rotation of the pad when the press lever moves upward, and the teeth of the feed ratchet are thereby rubbed against the upper feed dog, in order to push it aside to allow one tooth to pass.

The unison device and transmitting apparatus will be described in our next article.

(*To be continued.*)

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THE PORTABLE ELECTRIC LIGHT COMPANY.

OWING to advertisements appearing in the daily papers of late, respecting an apparatus sold by the above company, under the name of the "portable electric lighter," we have received numerous inquiries as to what this machine is, and what it will do. There appears to be a wide-spread notion, a mistaken one, as our readers will see, that the apparatus is in fact a portable electric light, capable of furnishing, by the aid of a battery, an illumination similar in kind to that furnished by the well-known incandescent electric light.

For the information of our readers, therefore, we have enquired into the points in question, and find that the apparatus is in fact a portable electric *gas-lighter*, in which the current of electricity is produced by a battery furnished with the machine. By pressing a knob the current is directed through a spiral of platinum wire, which is thereby heated to a greater or lesser degree of incandescence, according to the strength of the battery. This glow, which is about equal in illuminating power to that of a red hot coal, can be used for the instantaneous lighting of gas, an oil lamp, or any other equally inflammable matter.

It is obvious, therefore, that the apparatus, on the scale in which it is constructed and sold, is entirely incapable of itself being used as an illuminator, or independent source of light.

Mr. Misell, the president of the company, at No. 22 Water Street, Boston, states that no deception was intended, that the apparatus was not adapted for electric lighting, but was only intended for use as a lighter, and that his company had never intimated that it was an illuminator; and that the company had refunded their money to, and taken back the apparatus from, all who had purchased them under a mistake as to their real functions.

We may add, that the idea involved in this device is a very old one, having been invented and practically put into use by Professor Moses G. Farmer, as far back as 1850, when he had his house lighted by electricity in this manner. Of course, the platinum spiral was larger, and the battery power proportionately greater, than in the apparatus just described. Owing to the disintegration of the platinum by rapid oxidation, but more, perhaps, on account of the enormous cost of an electric light produced in this manner, as compared with gas, the experiment was abandoned.

THE sinking of the Cimbria is a striking confirmation of the dangers of navigation, pointed out in the December issue of this publication It seems almost incredible, that floating towns, with hundreds of souls and millions of property, are still exposed to such risks, when such an efficacious remedy, as the electric light, is at hand, and when so many steamship companies would not forego its use for any consideration. After a few more disasters, perhaps, the English, and German governments, will make the use of the light, imperative on all steamers. The English Channel, St. George's Channel, etc., are thronged with craft from every land, and accidents must increase with the increase in contributing factors.

— A DESPATCH FROM South Sudbury. Dec. 31, 1882, says: "Numerous people in different towns of Middlesex and Worcester counties heard the services to-day at the Northboro Orthodox Church, via the telephone. The transmitter was placed in the church for the especial benefit of Dea. C. T. Chapin, whose residence is over a mile from his church, this action being necessitated by his feeble condition. The experiment was very successful, and was much enjoyed by people at a distance.

ELECTRICAL INDUSTRY IN FRANCE DURING THE YEAR 1882.

To the Electrician

I COULD not better inaugurate my correspondence with you, than by endeavoring to give your readers an exact resume of the condition of the electrical industries in our country, at the end of the year 1882.

The International Exhibition of Electricity, in 1881, gave origin to great expectations for the future, and while the ardor of financial speculation was then at its height, a number of gentlemen foresaw the advantage of organizing societies for the development of inventions relating to lighting and the transmission of force by electricity. It was then proposed, that one powerful association should be organized to purchase and promote the patents generally regarded as the most promising, and contribute to the progress of discovery, by devoting millions to it if necessary.

The combination in one single large company of the smaller companies, which possessed the patents for the Jablochkoff and Jamin candles, for the open incandescent lamps of Werderman and Reynier, and for the vacuum incandescent lamp of Maxim, was a first step in this direction. The organization under the patronage of the "General Union" Bank of "the company for the utilization of natural forces," was the second, and because of the failure of this financial establishment, the last.

The financial prostration at the end of the year 1881, was particularly disastrous for electricity, and exercised during the succeeding year an unfavorable influence upon its enterprises. The General Electrical Company was surprised into full settlement, and at one time it was feared that it could not withdraw from the difficult position into which its administrators had led it.

This was happily not the case, thanks to the intervention of Mr. Hyppolyte Fontaine, who can be considered as the most authoritative representative of the French electrical industry I have mentioned. By his initiative was founded "The Electric Lighting" company, into which were gathered the stray waifs of the previous company, Jablochkoff, Jamin, Maxim, etc., and which proposed to devote itself solely to the development of their processes, and at the same time to carefully abstain from financial speculation. Though hardly six months old, the new direction, by an exercise of uncommon judgment, have got the enterprise into good shape. It is now prepared to furnish electric lighting "plants," by continuous or alternating machines, on the Jablochkoff candle, or Maxim incandescent system; since, some time past, it has undertaken the development of the storage battery of Kabath. Avoiding a useless conflict with gas, it devotes its energies especially to the lighting of manufactories, etc., and the field of its applications is so extensive, that it is contented with the profits it draws therefrom.

The "Electrical Company," also under the direction of Mr. Fontaine, operates the Gramme patents for the transmission of force to a distance. It has progressed toward a certain number of installations, more especially in mines, for drawing the wagons or cars, but it has principally given attention to the study of electric machines, designed for this especial service, and is preparing the types it proposes to manufacture. It must not be forgotten, that if the electric transmission of force is much talked of, practical experiments in this direction, have so far been almost exclusively conducted with machines designed for electric lighting, which do not respond necessarily to the demands of an actual service, and therefore an entirely new form of machine is being constructed, which we shall soon see in operation.

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A company organized by Mr. Phillipart, under the title of the "Force and Light Company," has made considerable noise, and two years or more ago, it proposed to develop the Faure "accumulator," and counted upon it to revolutionize industrial operations. After numberless vicissitudes, it has determined that the Faure accumulators do not possess sufficient durability to render their use economical, and it has undertaken the development of the Sellon-Volkmar storage batteries, for which great things are promised, but which have not yet been subjected to tests, which dispel all doubts of their merit. The patents of Faure, Sellon and Volkmar, are represented in France by an English company.

The Lyons "Electric Lighting Company" commenced with the development of the Lontin's patent (for the dynamo-electric machine), of Marsanne (regulator), and others; but it was not slow to perceive that it failed a good electric machine, and it purchased towards the end of 1881, the patent of Brush. It has established divers lighting plants, notably at the "Place de Carousel, in Paris, and in certain railroad stations. The operation of these "plants," has very much improved of late, which illustrates the difficulty of organizing at first, the experienced service required for the management of the machines and lamps.

The Edison companies have been so far financial, rather than industrial enterprises. Their founders have preoccupied themselves so exclusively with selling licenses, in order to recover more or less of the money invested, that it is only within the last few months they have begun to manufacture material, and to make progress toward the establishment of operating plants. The waiting room of the Eastern Railroad, at Paris, has been lighted for three months with 16 candle Edison lamps very satisfactorily. The question of *net cost* is excluded in an experiment of this kind. We doubt, however, whether incandescent lighting, let it be by either system, can be cheaper than gas, except in the case of theatres, where other considerations will, sooner or later, nescessitate its exclusive employment.

This suggests that we must not omit to notice the illumination of the "Varieties" theatre, accomplished by the Phillipart company, with Swan lamps, Faure accumulators, Siemens' dynamo-electric machine, and a gas engine. From official statements, it seems that since this plant has been in duration the consumption of gas in the theatre has been almost doubled, which must calm the uneasiness of the gas people, and enable them to regard with tranquility the future of their business.

The experiments in the electric lighting of railway cars, by means of incandescent lamps and accumulators, charged by a dynamo machine, deriving its motion from an axle of one of the carriages, have not led to the adoption of the system. The experiment of lighting locomotives by the Sedlaczek regulator, attempted upon the Northern railroad, has terminated in the same way.

At this moment, the question of employing the electric light at the Opera, is under consideration of a special committee charged with its study. It has already received propositions for the Swan and the Edison lamps. As it is an undertaking of considerable magnitude, it would be imprudent to anticipate its result. In the meantime, the "Eden" theatre, among new improvements, has largely included electric lamps, of various, and in fact almost all kinds, both arc and incandescent. We shall reserve our comments upon its enterprise until after its inauguration.

In general, electric industry appears not to have made great progress during the last year. The existing societies have been all compromised temporarily by imprudent exaggerations, and cannot follow the example set for them by the English company. Recent inventions have been received coldly, and even with distrust, by capitalists; and, aside from those holding Edison patents, there have been no important companies established for the development of processes relating to electric lighting.

It must not, however, be concluded that the public is less interested in the question, on the contrary, the demand for isolated plants has been this year, from day to day, more frequent, and the want of sufficient material and operatives to supply it, has caused great embarassment, but we think it safe to assert, that at present the manufacture equals the demand. The new year presents itself under most favorable auspices, and it is only necessary to wait, to see electricity make rapid progress in the domains of lighting the saloons of luxury, and the workshops of industry.

It remains for us but to say a word about the electric transmission of force. The Electrical Exhibition, at Munich, was counted upon to demonstrate the superiority of the method of Mr. Marcel Deprez. He expected to transmit between Miesbach and Munich, by an ordinary telegraphic wire, a force of a certain number of kilogrammetres. Surveyed from a scientific point of view, the experiment succeeded; but from a practical standpoint, so much can not be said of it. They succeeded in receiving at Munich, at the most, 35 per cent. of the power expended at Miesbach, but by an unfortunate succession of circumstances, the machines have been each time disabled after some hours of service. The industrial solution of the proposition is therefore still to be sought, until an actual receipt (rendement) of 50 per cent. that theory fixes as the maximum, is obtained.

This "Miesbach-Munich" experiment, has given rise to a most lively dispute between certain savants, Mr. Marcel Deprez being opposed by Mr. Cabanellas and Mr. Maurice Levy, which is without great interest to the public, who are incapable of following the adversaries in a discussion chiefly carried on under a veil of algebraic formulæ. Mr. Marcel Deprez, however, far from being discouraged, pursues his investigations with unabated energy, and we doubt not, that he will sooner or later triumph over the unexpected difficulties that he met with in the establishment of his machine.

PARIS, January 9th, 1883. PH. DELAHAYE.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

VIII—FRANKLIN'S HYPOTHESIS OF POSITIVE AND NEGATIVE ELECTRICITY.

THAT a slight circumstance may sometimes initiate an important succession of consequences, is conspicuously illustrated by the fortuitous incident which interested Benjamin Franklin in the subject of electricity. In the summer of 1747, Mr. Peter Collinson, a Fellow of the Royal Society of London, and a gentleman who took much interest in scientific affairs, made a communication to the Literary Society, of Philadelphia, explaining what had recently been done in England in electrical experiments.

With his letter he sent a present of one of the glass tubes, then commonly employed to excite electricity, and directions for its use.

Starting as a tallow chandler's apprentice, Franklin had as yet attained a dignity little superior to that of an ordinary printer's boy. With three thousand miles of ocean to separate him from its seat, he had previously given no attention to physical science, and had nothing but its inborn energy to incite a revelation of the power of his remarkable mind. Possessed of the tube, however, he commenced repeating the European experiments with all the

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ardor of an enthusiast, and the skill and sagacity of a practised experimental philosopher; and four months from its receipt, he addressed to Mr. Collinson the first of a series of letters, describing matters of his own discovery.

His ambition, like that of his European contemporaries, seemed, for awhile, restricted to developing new illustrations of electrical phenomena designed to be amusing only; but while their most dignified representatives were still pompously presenting new suggestions of this class, Franklin's letters rapidly assumed a most dignified tenor, and they were soon announcing natural laws of the highest generality, which, though based upon experimental demonstrations of surprising beauty and clearness, first betrayed the Abbe Nollet, the teacher of the French royal family, into the indiscretion of disputing them, and eventually became of the utmost importance to mankind.

In point of fact, his letters became so fascinating, that to turn to them from the confused dissertations of his immediate predecessors, seems like a transition from the mists of morning twilight to the unclouded splendor of the midday sun.[1] Nothing, says Priestly, was ever written upon the subject of electricity which was more generally read and admired, and there is hardly any European language into which they have not been translated.

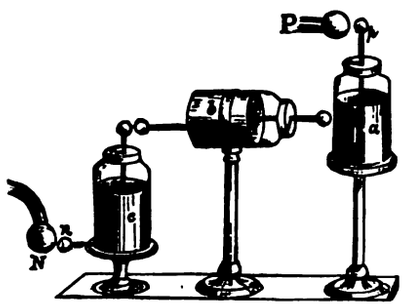

Fig. 84.—The charge by cascade. These insulated jars are so arranged that the outside of a, *nearly touches the rod from the inside of* b, *while a rod from the outside of* b *nearly touches that from the inside of* c. *The + prime conductor* P *of an electrical machine being brought near* p, *and the — prime conductor* N *near* n, *a spark appears at all the interruptions simultaneously, yet the jars are all charged.*[2]

Franklin's first step towards fame, was the establishment of the general principle, that when electricity is excited by the rubbing together of any two bodies, as glass and silk, both these bodies become electrified, and if both are insulated they remain electrified. They will, however, be in *opposite* electrical states, since, when movable, they *attract* each other; but yet, each of them exhibits in relation to other non-electrified bodies a like behavior. Sparks may be drawn from either; either of them may be de-electrified by being put in metallic communication with the ground. These facts he established by direct experiment.

He placed two persons, A and B, on insulating supports. In the hand of A, he put a glass tube, which being rubbed by A, became electrified. This tube was then touched at every part of the rubbed surface by B; after which the same process was several times repeated, the tube being deprived of its electricity as often as it was touched by B. A third person, C, not insulated, now presented his finger or a metallic sphere to B, from whom a spark was drawn; and by repeating this, or by touching the person of B, the latter was deprived of the electricity he had received from the tube. This was no more than was expected. But on subjecting A to the same process, the very same effects were produced. It appeared, therefore, that both A and B were electrified.

Being again electrified, as before, by the friction of the tube, instead of A and B being successively touched by C, they were made to touch each other, both remaining insulated. After this, both were found to be as completely de-electrized and restored to their ordinary state, as when they had been touched by C.

A cork ball, suspended by a silk thread, being electrified by contact with the excited glass tube, was repelled when brought near the person of B, but it was attracted when brought near the person of A.

From these experiments it appeared that the electrical states of A and B were different. The hypothesis, proposed by Franklin, to explain this difference was as follows: All bodies in their natural state are charged with a certain quantity of electricity, this quantity being in each body, of definite amount, and maintained in equilibrium upon the body by an attraction which the particles of the body have for it. Therefore, it exerts no attraction for other bodies. But a body may be invested with more or less electricity than satisfies its attraction. If it possess more, it is ready to give up the surplus to any body which has less, or to share it with any body in its natural state; if it have less, it is ready to take from any body in its natural state, a part of its electricity, so that each will have less than its natural amount.

When two bodies are submitted to mutual attrition, and become electrified, one parts with a portion of its proper electricity, which is received by the other. The latter then has *more* than its natural amount, and is *positively* electrified; the former has *less*, and is negatively electrified. Assuming that in the case of A, his body loses, and the glass tube gains electricity, then if when A rubs the tube, he be not insulated, he will not be electrified, because, as fast as his body loses its proper amount of electricity, the deficiency is made up from the earth, with which he is in free electrical communication; whereas, in the former case, being insulated, he would be electrified, because this supply could not be obtained. Hence, in this theory, the earth is regarded as the common reservoir of electricity from which bodies, negatively electrified, receive what they want, and to which bodies, positively electrified, give up their surplus, except in case of one or the other being insulated.

In the instance specified, Franklin called the state of *B*, and consequently that of the glass tube, from which he drew the electricity, positive, and that of *A*, negative. The one he considered as positively, the other negatively electrified. The cloth with which *A* rubbed the glass tube was, like *A*, negatively electrified; it attracted the cork ball; and the glass tube, like *B*, was positively electrified; it repelled the cork ball.

Such, in brief, was Franklin's hypothesis of positive and negative electricity, which, though since superseded, gave origin to the symbols + and —, still universally employed. Its assumption enabled him immediately to associate a multitude of scattered facts, and served as a clue to the analysis of many obscure phenomena, among which, those of the Leyden jar took precedence[3]. With reference to the discharge of an insulated jar[4], Franklin concluded, that before discharge its interior is *positively* electrified, and its exterior coating *negatively* electrified, in an equal degree; that is to say, that the interior contains an excess of electricity over and above its natural amount, and the exterior coating falls short of its natural amount by a quantity equal to that excess.

1. Lardner, Cab. Encyc. London, 1841, p. 26.
2. Rudimentary Elec., Sir W. Snow Harris, London, 1854, p. 80.
3. Ibid, p. 30.
4. See last sketch.

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It had been established in Europe, that a jar could not be charged unless its external coating communicated with the ground. Franklin considered this fact as in accordance with his theory, for, if it were true, no electricity could be conveyed to the inside of a jar, without causing the expulsion of an equal quantity from the outside. Therefore, an insulated jar could not be charged.

But such a jar could be charged if a means of escape were provided for the electricity on its outside; and it was while in pursuit of a demonstration of this proposition, that Franklin contrived the method of charging a series of jars, called, the *charge by cascade*. "Suspend two or more phials on the prime conductor, one hanging on the tail of another, and a wire from the last to the floor. An equal number of turns of the wheels will charge them all equally, and every one, as much as one alone would have been; what is drawn out of the tail of the first, serving to charge (the inside of) the second; what is driven out of the second, charging (the inside of) the third, and so on[5]." A modern arrangement of this experiment is shown in Fig. 34.

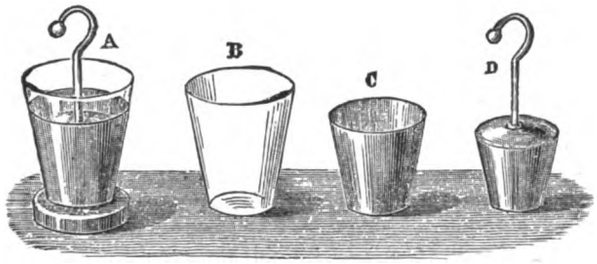

Fig. 35.—Showing where the electricity in a charged jar is stored. A is a charged Leyden jar. D, the interior coating, is first lifted out and shows no sign of being electrified. B, the glass, is then removed and is found to be electrified. Both C and D may be handled at pleasure, yet when the various parts are fitted together again, as at A, the jar will discharge almost as powerfully as though it had not been disturbed.

In this way he constructed an electrical battery. After charging a series of jars, he separated them, putting the insides in metallic communication with each other, and the outsides, in like manner, in metallic communication. From it he obtained discharges sufficiently powerful to kill the smaller animals.

But the experiment which appeared to be most conclusive, in the support it gave to his hypothesis, of the transfer of the electricity from the exterior to the interior of the jar, in the process of charging it, was the following: A jar was suspended by its hook on the prime conductor of the machine, so that a metallic communication was maintained between the conductor and the inside of the jar. Meanwhile, the rubber was insulated. On working the machine, the jar was found to receive no charge. A metallic wire was now rolled round the outer coating of the jar, and carried from thence to the rubber, so as to make a communication between them, both being still, in other respects, insulated. The jar was now charged with ease, which was explained by the supposition, that the electric fluid passed from the outside coating, by the wire, to the rubber, and thence, by the glass globe and prime conductor, to the inside of the jar.

According to the hypothesis above stated, there is no essential distinction, so far as relates to the charge, between the external coating and the internal contents of the jar; the one ought to be as easily charged as the other. This was accordingly found to be the case. A jar was placed on an insulating support, and while the external coating was put in communication with the prime conductor of the machine, the wire, extending from the interior, was put in communication with the rubber. The electricity of the outer coating was now positive, and that of the inside, negative; and the jar was discharged, and produced the same effects as before.

The next important investigation was, as to the place in which the electricity of the jar was contained. To determine this, Franklin charged a jar, and insulated it. He then removed the cork, and the wire, by which the electricity was conveyed from the machine to the inside of the jar; on examining these, he found them free from electricity. He next carefully decanted the water from the charged jar into another insulated vessel; on examining this water it was found to be free from electricity. Other water in its natural state was now introduced into the charged jar to replace that which had been decanted; and on placing one hand on the outside coating, and the other in the water, he received the shock as forcibly as if no change had been made in the jar since it was first charged. For this experiment, the jar with separable coatings, Fig. 35, is now employed.

A piece of glass was then placed between two plates of lead, extending nearly to its edge on every side. One of these plates of lead being touched by the hand, the other was charged with electricity as usual. The plates were then removed from the glass, and, being examined, were found to be in their natural state. On presenting the finger to the glass, where the lead had covered it, little sparks were received; and on replacing the lead and touching it at both surfaces, a violent shock was received.

From this he inferred, that the glass was the substance in which the electricity was deposited; and the metallic coating, or the water, or other conductor applied to it, "served only, like the armature of the load-stone, to unite the forces of the several parts, and bring them at once to any point desired."

5. Franklin's Works, by Jared Sparks. Boston, 1856. Letters, Vol. 5.

—— THE OBJECTION FOUND by ladies to the telephone—that they could talk only one at a time—has been remedied by a new, duplex, reciprocal sort of invention; and now two ladies, one at either end of the wire, can both talk to each other at the same time as comfortably as they could if both were together in front of a dry goods counter.—*Texas Siftings.*

—— A PERSON WHO was very much annoyed by cats running along his piazza, laid wires about an inch apart on the floor, the alternate wires connecting with the terminals of a primary coil; and in walking over these wires, they completed the circuit, and received a shock whose severity may be imagined when it is stated that it overcame the pussie's love of locality. A similar apparatus, with one conductor laid along the rail, and the other on top of a board fence, caused the puss to jump about three feet in the air, and with a mighty spit and bristled tail challenged the mysterious enemy the instant of landing—on her feet, of course. This summary dealing with animals may seem vindictive, but they do much for our discomfort; and in the words of the youth scratching his head, "They began it first."

—— AT A RECENT MEETING of the Buda-Pesth Society of Natural Science, Prof. Than (a member of the committee appointed to investigate theatre fires) spoke on the danger of ordinary gas, and the means of reducing it. From experiments, he was of opinion that gas was not dangerous so long as it occupies less than 5 per cent, of a given space; between 5 and 12 per cent. it begins to be ignitable, and at 29 per cent. the danger of explosion is present in high degree. He has improved Anselm's apparatus (which, acting on the principle of diffusion, causes an electric bell to ring as soon as a certain quantity of gas is present), so that even 1-2 per cent. of escaped gas causes loud ringing. Another ingenious arrangement shows the actual percentage quantity of escaped gas, while a control-manometer, which Prof. Than has used several years in his laboratory, reveals the place of escape of the gas.

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PARIS CORRESPONDENCE.

PARIS, January 11 1883.

To the Editor of the Electrician.

DEAR Sir—Having lately had the opportunity of visiting both Italy and Spain in connection with electric lighting, I thought that a few remarks on the general aspect of the electrical industries in these countries would be of interest to your readers. In the first place, I visited Turin, where a most cordial reception was accorded me by Messrs. Engel & Bracchi, two enterprising gentlemen, who have introduced into Italy the Otto gas engine, with much success, and who are now exerting every effort to popularize the electric light. They have lately installed in a cotton factory at Turin, a Weston dynamo machine, and 10 Weston lamps; and judging from remarks made (on the first night of lighting up), both by the directors and operatives, there is no doubt that the Weston apparatus is as much appreciated in Europe as it is in America.

I also noticed that one of the most prominent stores at Turin was lit up with splendid effect by 36 Maxim incandescent lamps, the current being supplied by a Siemens alternating machine, driven by an Otto 8 horse-power gas engine. On the intermediate shafting in this installation, was placed a drum, fitted with powerful springs, which were arranged to act on the shaft in such a way as to keep its speed regular, and not liable to the pulsations of movement as are produced by nearly all gas engines when worked up to their full power. This arrangement worked fairly well; but for perfectly regulating an unsteady supply of electric current, there can be no mechanical arrangement that can compete for efficacy with the placing of a few accumulators in derivation from the main circuit.

The railway station at Milan is lit up, both inside and out, by 6 large Siemens lamps; each lamp has a separate generator, and the 8 Siemens machines (2 being used as exciters for the rest), are driven from 2 20 horse-power Otto gas engines, placed in the station. Messrs. Burgen and Edison are also busy at Milan; and although electric lighting, on a large scale, is not so far advanced as it is elsewhere, yet one is much struck by the energy and enterprise of a few individuals who are leaving no stone unturned to popularize this new business. I may mention that Messrs. Engel & Bracchi, of Turin, are contemplating to utilize, by means of electricity, the immense water power that flows through Turin, and which is kept always at the same level by the municipality of the town. Their project is to place turbines and dynamos at different stations along the river, and wherever light or power is required in the city they will dispose a sufficient number of Kabath accumulators. If this project is carried out, it will demonstrate one of the most practical and valuable applications of accumulators, which are now attracting so much notice, and without which, no electric light installation will be considered as complete.

At Barcelona the electric light industry is on a firm and solid basis; and this is due to the existence of the Sociedad Espagnol d'Electricidad, of which M. Cuadros is the president, while M. Ziffra fills ably the post of engineer. I have no doubt that the success which attends all the undertakings of this company, is due, in a great degree, to the indefatigable energy and ability of their engineer. Their factory is in full working order, and among other things, they manufacture Gramme dynamo machines of several types, Gramme arc regulators, Maxim incandescent lamps, and before I left they had commenced the manufacture of Kabath accumulators. From this factory they also supply the current for 15 Gramme regulators, which light up the whole length of the quay; these are driven from 3 5 light Gramme machines. Two of the principal cafés are also lit up respectively by 88 and 96 Swan lamps, and the installation at the Café del Oriente is very complete, and comprises the following: For the general lighting of this café there are 96 Swan lamps, which are arranged in 8 series of 12 lamps, in derivation in each series, while the 8 series are connected up in tension. The generating machines, for supplying the necessary current are 2 Gramme 5 light machines, coupled together for tension, and running at a speed of 900 revolutions per minute, which gives them about 250 volts each. The total resistance of the wire circuit is about 10 ohms, while each lamp has about 60 ohms cold, and requires 1.4 to 1.6 ampères. To this installation has lately been added 70 Kabatn accumulators, which are placed in the café and find themselves in a derivation from the main lighting current. By this means they act as a regulator on the main current, and at the same time become charged, so that in case of accident there is always a reserve force of electricity to fall back on. By means of a commutator, the garcon at the café can at any moment, in case of accident, put the accumulated charge of the accumulators in connection with a circuit of 16 50 candle power Maxim lamps, and thus avoid any scare.

I think it is easy to predict that electric accumulators will shortly make a greater stir in electrical affairs than did the first practical introduction of incandescent lamps.

I remain, gentlemen, respectfully yours,

CHARLES W. FARQUHAR.

SHELBYVILLE, IND., January 11, 1883.

Williams & Co.:

Gents:—Noticing an article, in the current ELECTRICIAN, on "Underground Cables," the subject of proper material to be used suggested, Wood, as being, under certain processes, made not only water-tight, but non-conducting. I have a process of making wood pipe, any size, that I am sure would be preferable to metallic pipe, for cheapness, lightness, and thoroughly water-proof, and can be furnished in lengths to suit, twenty, thirty, fifty, to one hundred feet long. The materials are soaked in boiling asphaltum, and all moisture driven out by this mode of manufacture. The process of making is, a mandrel, of required size and length, is covered with a thin veneer of wood, sawed just at joint, and a narrow strip of veneer wound around from end to end spirally, with the second narrow strip wound in the opposite direction by turning the mandrel. The wood first being subjected to boiling asphaltum, driving out moisture, and making the strips pliable and perfectly waterproof. A company will soon be formed for its manufacture.

If not too much trouble, please give this a notice in your valuable journal.

H. M.

ELECTRIC UNITS.

THE following is a synopsis of the resolutions adopted by the International Conference held in Paris, last October, for the purpose of fixing electric units:—

1. ELECTRIC UNITS PROPER.

Resolution 1.—The Conference holds, that in the nomenclature, adopted hitherto, there does not as yet exist that perfect agreement which is necessary to fix the numerical value of an ohm in the column of mercury. Further searches are, therefore, required. Without wishing to set forth any opinion on the different methods which have not yet been definitely tested by experience, the Conference looks upon the subjoined methods as more particularly calculated to yield very accurate results, viz:—1. The induction of a current upon a closed circuit (Kirchoff's method); 2 The induction by the earth (Wilhelm Weber's method); 3. The amortization of movable magnets (Wilhelm Weber's method); 4. The instruments of the British association; 5. Lorenz's method. On the other hand, it is desirable that the quantity of heat set free by a current of common intensity, should once more be determined, for the purpose both of controlling the value of the ohm, and of fixing the mechanical equivalent of heat more accurately.

Resolution 2.—The Conference calls upon the French government to adopt the necessary steps to enable one and the same standard, or several standards of resistance, being placed within the reach of those engaged in theoretic investigations, so as to render comparisons easier.

Resolution 3.—The Conference holds, that as soon as the results of the various searches that have been made shall agree with one another, within one-thousandth, this approximate accuracy shall be considered near enough to determine the value of the standard of resistance for practical purposes.

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Resolution 4.—The Conference calls upon the French government to place itself in communication with the other governments, represented at the Conference, in order to induce each of these, by reason of the importance and urgency of a practical solution, to adopt such measures as may be calculated to encourage further investigations on the part of subjects of such governments, with a view to the accurate determination of electric units.

2. Electric Currents and Lightning Conductors.

Resolution 1 —The Conference expresses a wish that all the governments, represented at the Conference, should encourage regular and continuous observations of atmospheric electricity.

Resolution 2.—The study of storms ought, in the opinion of the Conference, to be extended over all countries.

Resolution 3.—The Conference holds, that, in each country, certain portions of the general telegraphic system, however small such portions may be, should be set aside exclusively for the study of terrestrial currents.

3. Determination of a Standard of Light.

The Conference, finding that previous investigations have given rise to a hope that the light produed by incandescent platina may eventually yield an absolute standard, holds that such researches should be continued.

As a secondary standard for general use, the Conference recommends the Carcel lamp, which, as a vehicle of verification, was invented by MM. Dumas and Regnault. Candles also may be used if sufficient care be taken to insure absolute identity in their composition, form, construction, and consumption. In the case of minute observations, and for certain practical applications, *e.g*, in lighthouses, the comparison of the various lights is to take place by means of an analysis of their various constituent elements.

The Conference presses the decision, arrived at by the Congress of 1881, laying down the rule, that in determining an electric focus, and generally any focus from which a radiation is to take place in different ways in the various directions, the formula of that focus, that is to say, the relation that exists between the intensity of the light, and the direction of the rays, shall form an essential element.

PHOTOMETRIC STANDARDS.

THE standard of light in use in France, is the Carcel burner, which is a light produced by burning in one hour 42 grammes of refined colza oil. the flame being 40 millimetres high. The following are the rules laid down by MM. J B. Dumas and V. Regnault in their method of checking the lighting power of gas :—In England, the legal unit of light is that produced by a spermaceti candle, six to the pound, burning 120 grains per hour. The Carcel burner is equal to 9.5 candles. In Germany also, candles are used as standards of light. A paraffine candle, 20 millimetres in diameter, burning with a flame of 5 centimetres in height, is the unit adopted. A Carcel burner is equal to 7.6 of these paraffine candles. There are two other standards of light, but these are more particularly intended for photometric comparisons with the electric light, the foregoing standards being too weak for that light, and varying from it too much in regard to shades of color. The two special standards in question are not supplied by flame, but by an incandescent piece of platina. The first is the Schwendler standard, in which a thin piece of platina is brought up to white heat by an electric current of a specific and constant intensity passing through it. The second is the Violle standard, which was laid before the Congress of Electricians in 1881. It consists in the light produced by a surface of 1 square centimetre of pure platina, kept up to the melting point, and consequently, at an absolutely constant temperature.

—— Some young men, wishing to experiment with the physiological effects of the arc lighting current, ran the wires of a thirty-light dynamo through a trap which contained a live rat. The dynamo was started, and when the rat happened to stand on both wires, the cross current not only killed, but burned the rat.

ELECTRIC LIGHT IN GERMANY.

AT Berlin, some perplexity has arisen with respect to the lighting the interior of the Opera House by means of electricity, which the authorities have come to look upon as, by far, the best way of lighting a place of that kind. The police would never think of allowing a steam engine, or even a gas motor, for working the lamps, to be put up inside the building. The captain of the fire company holds, that it would be equally dangerous to put up the machinery in the property shop in the Behrenstrasse. It has now been proposed to turn the water power, of what used to be Werder's mills, to account, for working the electric machinery which is to light up the two Court theatres. In the Wilhelmstrasse, the experiments with Edison's incandescent lamps were discontinued on the last day of last year. The machinery is to be used in the Academy of Arts for the lighting of the exhibition of antique pictures and other works of art, to be held there in connection with the forthcoming silver wedding of the Crown Prince and Princess of the German Empire. In the Kochstrasse, from the Markgrafenstrasse to the Friedrichsstrasse, 20 of Siemens' incandescent lamps have lately been put up by way of experiment. Each of these lamps has 120, in lieu of what used to be 17-candle power; and the force required for working 20 lamps, amounts to from 15 to 20 horse-power. At Munich, a certain engineer, Herr Landes by name, has petitioned the municipality for leave to put up an electric central station with hydraulic machinery for the whole of the Isar Bank. He expects to derive 360 horse-power from the use of the water, which power he proposes to turn to account for lighting the Royal Court Theatre, the Residence, and the Maximilianstrasse. A committee has been appointed by the Municipality to ascertain whether it would not be more advisable for the town to take charge of the matter on its own account.—*Ironmonger*.

UNDERGROUND TELEGRAPHS IN GERMANY

IN the German Empire the length of the telegraph lines, above ground, has risen, since 1879, from 29,944 to 35,243 miles, which does not include the urban telephone lines. As regards the extensive subterraneous telegraph net, created since 1876, its length, at the end of March, 1879, amounted to 1.545 miles, with 10,402 miles of conduits; at the end of last March it had been increased to 3,399 miles in extent, with 23 252 miles of wire. This shows an increase of 1,154 miles in the length of the lines, and of 12,850 miles in that of the circuits. The following is a list of the 20 lines, of which the underground telegraph net of the German Empire is composed :—1, from Berlin, *vid* Halle, to Frankfort-on-the-Main and Mayence; 2, from Frankfort-on-the-Main to Strasburg (Alsace); 3, from Strasburg to Metz; 4, from Berlin, *vid* Magdeburg and Hanover, to Cologne, and thence to Aix-la-Chapelle; 5, from Cologne, *vid* Coblentz and Treves, to Metz; 6, branch line from Halle to Liepzig; 7 branch line from Cologne to Barmen; 8, connecting line between Coblentz and Mayence; 9, from Berlin to Dresden; 10, from Berlin to Hamburg (cable 1); 11, same circuit, second cable; 12, from Hamburg to Kiel; 13, from Hamburg, *vid* Bremen and Olsenburg, to Emden; 14, branch line from Hamburg to Kuxhaven; 15, from Bremen to Bremerhaven; 16, from Sande to Wilhelmshaven; 17, from Berlin, *vid* Stettin, Köslin and Danzig, to Königsberg; 18, from Berlin, *vid* Küstrin and Posen, to Thorn; 19, connecting line between Thorn and Danzig; and 20, from Berlin, *vid* Frankfort-on-the-Oder and Glogan, to Breslau. The construction of these lines occupied, altogether, fifty-eight months, and the cost amounted, roughly, to 1,500,000*l*. The subterranean system connects 221 towns with one another, amongst which are to be found all the most important centres of commerce, and all the principal fortresses situated within the province of the Imperial Telegraph Management; all the principal river-beds of that province are also crossed by these lines, which have added immensely to the safety of the telegraphic communications within the Empire, as has now been shown by several years' experience.

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SPARKS.

—— THE *Hearld* calls the gas-meter a mechanical Ananias.

—— THE ELECTRIC RESISTANCE of 100 yards of No. 8 iron wire is, roughly 1 ohm.

—— THE DEATH IS announced of Karl Winter, the well-known electrician. He died at Vienna, on December 7th, last.

—— SOME OF THE sugar planters at the Sandwich Islands, are now cutting their sugar cane at night, by the aid of the electric light.

—— A ROCHESTER PAPER states that the Brush Electric Light Company, are expecting to transmit electricity, on a large scale, at the lower falls of that city.

—— A "GRAVEYARD ELECTRIC ALARM CO.," is organizing in Cincinnati, to detect any disturbance of the remains, whether from return to life or from ghouls.

—— EXPERIMENTS WITH THE telephone were made at Boston, on January 14th with various lines reaching to Togas Springs, Maine. Conversation was easily carried on over 230 miles of wire.

—— BESIDES THE UTILIZATION of small incandescent lamps as ornaments for fairies, &c., several of the London theatres are abolishing the lime-light apparatus, and using arc lights, fitted up much in the same way as they are on board men-of-war.

—— M. MARCEL DEPREZ explains, that in his Miesbach experiments, the 60 per cent. referred only to the electrical effect; the power actually transmitted for industrial purposes, was 25 per cent., in the first, and 30 per cent. in the second experiment.

—— COL. J. C. MCLAUGHLIN, of the Florentine Hotel, Cincinnati, has just patented an electric alarm bell, to be fixed in each hall of a hotel, which, upon notice of fire reaching the office, whoever is in charge may, by simply touching a button, set it going and create a noise through out the building that might awaken the dead.

—— ON JANUARY 11TH, a fire was discovered in a house in Boston, and it is the opinion of legal gentlemen, that the city is liable for the damages, because the notice over the fire alarm box stated, that the key was kept in a house which was torn down three years ago, and much delay was caused by the search for the person who had charge of the key.

—— THE GLASS GLOBES, hitherto used to moderate the intensity of the electric light, diminish the light to a large extent, seldom less than 50 per cent. (according to *Sprechsaal*). A French paper has recommended the use of globes, etc., made of spun glass for the purpose. Experiments proved that such did not absorb more than 25 per cent. of the light.

—— AT THE GAS EXHIBITION, at the Crystal Palace, in London, there is a great collection of all the best systems of improved gas lighting. Mr. Sugg exhibits an immense standard lamp of 1000 candle power, and a series of suspended lanterns of 600 candle power. There are similar great gas lights by Bray, Siemens, and others, which are submitted as competitors against the electric-arc lights.

—— A DESPATCH FROM Norfolk, Va., January 24, says: "The steamer Snowdrop will leave for Hampton Roads to-morrow morning to lay the cable, and carrying a lot of spars and other apparatus made at the yard for the torpedo experiments, which are to take place under the supervision of Lieutenant Graydon. The system is in the order of an endless chain, to which the torpedoes are attached. This cable is kept in motion by a small portable engine, and as a vessel goes over it, the torpedo is fired by electricity. The cable will be laid from Fortress Monroe to the Rip Raps.

—— M. DE CHANGY, one of the first electricians who attempted to manufacture incandescent lamps *in vacuo*, about twenty years ago, has constructed a small model for demonstration. The carbon is rectilinear, which permits a very small length to be given to it. It is to be lighted with bi-chromate of potassium elements. In his former attempts, M. de Changy advocated very small carbons cut in the graphite from the retorts. Now his fibres are carbonized according to the common practice.

—— SOME INTERESTING EXPERIMENTS have been recently made on French railways with an electric alarm, invented by M. Mors, forewarning the approach of trains. This ingenious, though simple apparatus, consists of a box filled with mercury, which is placed under the rail at any desired distance from the signal bells. In consequence of the vibration, when a train is passing, the mercury contained in the box is much agitated, and makes an alternating connection with the wires, which are in communication with the bells.

—— ELECTRICAL ENGINEERING. At Tuft's College, near Boston, a new course in electrical engineering has been established. The course is under the supervision of Prof. A. E. Dolbear, one of the pioneers of the telephone, and eminent for his electrical inventions. This department embraces instruction in wood and metal work at the vise and lathe, practice in running the steam engine, and an extensive experimental course, with electric and acoustic apparatus, with special reference to the application of telegraphy, telephony, and electric lighting.

—— THE NEW YORK *Tribune*, of January 24, says, that the large iron building on the north side of Liberty Street, between Broadway and Nassau Street, has been purchased by the United States Electric Light Company, for $285,000. The United States Illuminating Company, which has charge of the company's business in this city, will remove its office into the newly purchased building, as the present quarters in Chambers Street, are too small for its largely increased business. The manufactory of the United States Electric Light Company will remain at Newark.

—— THE BARK GEMSBOK, which arrived at New York, December 27, 1882, from Auckland, reports that on October 9, at 4 P. M., while running in a south-west gale, and during a thick snow squall, a ball of fire passed over the ship, injuring F. Olsen, mate, in both wrists; Charles Blumberg, at the wheel, in both wrists; and Herbert Makely in the head; breaking both gunwales, and ripping the planks from the stern of the starboard boat, and exploding about twenty yards from the ship, with a loud report, sparks flying from it like a rocket. There was no lightning or thunder at the time.

—— A SIMPLE GALVANOMETER, free from all magnetic actions, is described by M. Dubois in a letter to *La Lumière Electrique*. It is based on Joule's law, and is merely a Breguet thermometer, the spiral of which is formed of a fine strip of platina and zinc, or of platina and iron, which is traversed by the current to be measured. To compensate variations of exterior temperature, the spiral traversed by the current is suspended by means of a second quite similar spiral turning the opposite way. The first spiral has a pointer near its lower end, which end dips in a mercury cup, while an annular cup of mercury serves for the upper contact (the current passing half up one support then down the slip). The sensibility of the instrument increases with the intensity of the current.

—— RECENT EXPERIMENTS by Prof. Kohlrausch, of Germany, lead him to the result, that silver chloride, bromide, and iodide conduct electricity, at temperatures above their melting points, much better than the best-conducting sulphuric acid (that is, the best-conducting liquid conductor at ordinary temperature). The chloride conducts best; the bromide comes next; then the iodide. The resistance of silver chloride and bromide increases very much and quickly in solidification of the substances; and on cooling to 20°, it rises to more than a million times the initial value. Iodide of silver, on the other hand, does not alter in resistance in solidifying; but first shows a rapid increase of resistance at 145°, the temperature at which it passes from the amorphous into the crystalline state.

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—— AT THE LAST WINTER conversazione of the Royal Microscopical Society, London, great interest was manifested in an exhibition of the electric light applied to microscopical illumination. The arrangement was the device of Mr. C. H. Stearn (who exhibited it), and consisted of two minute Swan incandescent lamps, one applied beneath the stage and the other above, for opaque objects The lamps were so small that they could be brought quite close to the object, and the illumination they afforded was very brilliant A small battery was used with the lamp. Mr. Stearn is experimenting with the view of using a small dynamo, driven by clockwork, so as to get rid of the inconvenience attendant upon the battery. He proposes to read a paper on the subject at the next meeting of the society.

—— MR. WILLIAM MARTIN, of the Western Union Telegraph Co., and one of the oldest and most noted telegraphists of this country, died in Boston, on the 4th of January. The Boston *Herald*, in referring at some length to Mr. Martin's death, says, "that his career was part of the history of telegraphy in America; that from the little company of nearly half a century ago, he came down on the surface of amalgamations and consolidations to the great and powerful organization known all over the world—that he was a warm friend of Prof. Morse, the inventor of the telegraph, and when the latter was in Boston, he never failed to call on him—that though he was immensely popular with the general public, with whom he had dealt so many years, yet his kindly qualities were best known to those with whom he was daily associated." The same paper states that leading representatives of the Western Union Co., the Gold & Stock Telegraph Co., the Rapid Co., the Mutual Union Co , the Merchants Dispatch Co., the Cunard Line, and gives the names of many prominent business men of Boston, who paid their final tribute of respect to Mr. Martin's memory.

—— ONE OF THE PIONEERS in the modern applications of electricity, who lived in the quiet city of Salem, Mass., was very much troubled by the boys, who would ring his front door bell, which was so conveniently near the sidewalk, that few boys could resist the temptation after dark. After patience had ceased to be a virtue, our scientific friend made a special bell knob, in which two highly ornamental rings connected with the poles of a powerful battery. The connections were made after dark, and soon a ring was heard, coupled with cries of fright and pain, from the front door, where a youth was trembling with his hand contracted upon the knob, so that he could not release his hold. After the current was switched off, and the boy likewise, the trap was set for a fresh victim. Soon very harsh language, in a base voice, was heard; but this time it was the clergyman on a pastoral call. There was some talk of a church trial, but the only notice ever taken of the matter, was by a boy's debating club, who announced a public debate on the topic, "Is swearing *ever* justifiable," and invited the reverend gentlemen to open in the affirmative.

—— THE *Comptes Rendus* says, that in 1826, M. D. Colladon published an account of disturbances of his galvanometer by a storm, which was so far from Paris that no clouds were visible within 30 degrees of the zenith. Peclet, in his *Traité de Phisique*, gives a note upon Colladon's observations, in which he says: "During a storm the needle of the galvanometer is in continual motion; each flash is immediately followed, sometimes even preceded, by a sudden change even in the direction of the deviation, or by a violent increase. In some cases the deviation passes instantly from the positive to the negative maximum, or inversely; these effects continue even when the flashes are two or three leagues off, provided the air is very damp and the sky covered with clouds." In 1879 M. Renè Thury, son of a professor in the University of Geneva, stretched a copper wire, horizontally, between two houses, at the height of the roofs, and communicating with the earth by means of water pipes. Two telephones were connected with the wire, one of which had a resistance of 4.5 ohms. In every thunder storm the flashes of lightning have always been accompanied by a very characteristic crackling in the telephones. This noise is heard at the same instant that the flash is seen, whatever may be its distance, and results, consequently, from the induction of the distant discharge upon the wire. Every flash which is visible to the eye is heard in the telephone, even when it is so distant that there is no audible thunder.

—— IN THE SYSTEM of electric illumination of trains, recently adopted on the Eastern railway of France, there is a Gramme machine (driven by the locomotive) and accumulators. M. Tommasi has introduced an "automatic interrupter," the action of which is to break all communication between the Gramme machine and the accumulators, when the speed of the train descends below the normal Further, if the lamps are lit at such a time, or when stoppage occurs, the automatic apparatus substitutes the accumulators for the machine, or reciprocally, the moment of change is not perceptible. When the train is running without the lamps being lit, the Gramme machine charges the accumulators exclusively; when the train is lit, the machine feeds both the lamps and the accumulators. It is only when the illuminated train slackens speed or stops, that the accumulators supply the current required by the lamps, and this is restored when the train has resumed its normal speed. Thus the accumulators are not so cumbrous as if they had sufficient capacity to feed the lamps during the whole journey. There is a Swan lamp in each compartment. The train is lit by the guard on entering a tunnel. The cost for an ordinary train of 36 lamps is about 12 francs a day, whereas the lighting with oil cost 36 francs and was very imperfect.

—— A LETTER, RECEIVED from an officer of the United States steamer Alaska, gives an interesting account of a meteor, which was seen from the ship on the evening of December 12, 1882, a few minutes after sunset, in lat. 38° 21′, lon. 134° 7′. The sun had just sunk clear, leaving the lower sky streaked with gorgeous tints of green and red, while the new moon gave out a strange red light, of wonderful brilliancy. All at once a loud, rushing noise was heard, like that of a large rocket descending from the heavens with immense force and velocity. It was a meteor, and when within 10° of the horizon it exploded with much noise and flame, the fiery fragments streaming down into the ocean like great sparks and sprays of fire. The most wonderful part of the phenomenon followed, for at the point in the heavens where the meteor burst, there appeared a figure like the shape of an immense distaff, all aglow with a bluish light of intense briliancy. It kept that form for perhaps two minutes, when it began to lengthen upward and grow wavy and zigzag in outline, caused by the action of the wind, and gradually diminishing in breadth until it became a fine, faint spiral line at its upper end, dissolving into the fast gathering clouds the meteor seemed to have evoked. It remained for about ten minutes, when it began to fade, and finally disappeared at 5.11 o'clock.

BUSINESS NOTICES.

WANTED—By a young man having a thorough scientific education, with a knowledge of electricity and some experience—a situation with an electric light company, where he can learn thoroughly and *practically* the duties of an electrical engineer. Best of references.
Address J., 114 East 22d St., New York.

WE are in receipt of the current number of *American Progress* which contains extended notices of Courtenay & Trull s gelatinized fibre, Faure's accumulators, and the Cumming periphery contact disc-electrodes. Parties desiring information, in regard to the latter invention, should address Cumming & Binkerhoff, 219 E 18th Street, and receive their eight-page illustrated descriptive circular.

BOOKS every Electrician and Student of Electrical Science should have. ALLISON'S DICTIONARY OF ELECTRICITY AND ELECTRICAL AND TECHNICAL TERMS, with numerous Illustrations of the Newest Electrical Inventions and Apparatus. 12mo. cloth, 192 pp. Price $2 00 post paid. Also, ALLISON'S WEBSTER'S COUNTING HOUSE DICTIONARY AND DICTIONARY OF ELECTRICITY. Cloth, 12mo. 576 pp. 500 Illustrations. Price $3 00 post paid.

This is the most instructive and comprehensive dictionary, as well as the *newest and best revision of Noah Webster's Counting House Dictionary* ever offered to the American people. It is besides, the *only dictionary of electricity, electric motors, dynamos, &c.*, in the world, and covers the whole subject, now so interesting to every city in the United States (or elsewhere), of Electric Lighting, Telephones, Telegraphy, &c. For either, or both, of the above works, address the publishers,
WM. J. ALLISON, Tribune Building, N. Y.

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PATENTS FOR DECEMBER, 1882, AND JANUARY, 1883.

DECEMBER 26th.

269,559 Electric Current Meter. A. Bernstein, Boston, Mass.
269,605 Electric Machine, Dynamo. E. Thomson, New Britain, Conn.
269,761 Electric Machine, Dynamo. E. Weston, Newark, N. J.
269,805 Electric Machine Regulator, Dynamo. H. S. Maxim, Paris, France.
269,606 Electric Machine Regulator, Dynamo. E. Thomson, New Britain, Conn.
269,593 Electric Safety Apparatus for theatres, and other buildings. C. A. Mayrhofer, Vienna, Austria-Hungary.
269,568 Electrical Conductors, Conduit for. W. B. Eltonhead, Philadelphia, Pa.
269,807 Insulating Wires. L. H. McCullough, Richmond, Ind.
269,759 Lamp, Electric Incandescent. E. Weston, Newark, N. J.
269,757 Lamp Holder, Incandescent Electric. E. Weston, Newark, N. J.
269,526 Lamps, Apparatus for Suspending, Raising, and Lowering Electric. C. C. Jennings, Buffalo, N. Y.
269,758 Lamps, Suspending and Circuit Controlling Mechanism for Arc. E. Weston, Newark, N. J.
269,794 Medical Induction Coil, Electro. J. Kidder, New York, N. Y.
269,735 Telegraph and Telephone Cable. J. Speicher, New York, N. Y.
269,634 Telegraph Printing. W. J. Burnside, Hilcot Court Road, Lower Norwood, County of Surrey, England.
269,521 Telegraph Transmitter, Electric. E. M. Hamilton, New York, N. Y.
269,657 Telephone, Speaking. G. A. Fitch, Oakland, N. Y.
269,760 Rheostat. E. Weston, Newark, N. J.

JANUARY 2nd.

270,125 Time Detector, Watchman's Electric. J. E. Richards, Cedar Keys, Fla.
270,056 Time Pieces, Electric Synchronizing Apparatus for. J. Hamblet, Brooklyn, N. Y.
270,186 Vehicle, Electric. J. R. Finney, Pittsburg, Pa.
269,860 Annunciator, Oral. J. Ireland, Cleveland, Ohio.
269,862 Burglar Alarm, Electric. C. T. Jackson, New York, N. Y.
270,017 Electric Machine, Dynamo. A. Chertemps, and L. Dauden, Paris, France.
269,888 Electric Motor. W. L. Silvey, Castleton, Ind.
269,868 Electric Wire Cable. J. Mackintosh, Philadelphia, Pa.
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269,937 Lamp, Electric. C. A. Hussey, New York, N. Y.
269,938 Lamp, Electric arc. C. A. Hussey, New York, N. Y.
269,939 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
270,157 Mallet, Electric. J. R. Finney, Pittsburg, Pa.
269,879 Telephone, Electric. H. B. Porter, Chicago, Ill.
269,884 Telephone Transmitter and Receiver. J. H Rogers, Washington, D. C.
270,136 Telephonic Transmitter. G. E. Shaw, Chicago, Ill.
269,960 Thermostat, Electric. T. Reeve, Brooklyn, N. Y.

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270,248 Car Brake, Electrical. A. S. Parsons, Huntington, W. Va.
270,583 Clocks, Electrical Control for Pendulum. R. W. Willson, New Haven, Conn.
270,478 Coupling for Wires and Electric Conductors. H. F. Pumphrey, Fairfield, Iowa.
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270,491 Electric Light. H. A. Seymour, Washington, D. C.
270,230 Electric Machine, Dynamo. J. Lewis, Chicago, Ill.
270,325 Electric Machine, Dynamo. J. J. and T. J. McTighe, Pittsburg, Pa.
270,518 Electric Machines, Apparatus for Cooling the Armatures of Dynamo. P. H. Van der Weyde, New York, N. Y.
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270,449 Lamp, Electric-arc. S. Martin and J. F. Richards, Pittsburg, Pa.
270,379 Lightning Rod. J. H. Brandon, Chicago, Ill.
270,457 Magneto-electric Machine. A. Millar, Glasgow, Scotland.
270,209 Railway, Automatic Electric. E. N. Dickerson, Jr., and C. G. Curtis, New York, N. Y.
270,556 Telephone Exchange System. C. A. Randall, New York, N. Y.
270,326 Telephone Switch. T. J. McTighe, Pittsburg, Pa.
270,522 Telephone Switch. T. A. Watson, Everett, Mass.
270,500 Telephonic Circuit. J. M. Stearns, Jr., Brooklyn, N. Y.
270,551 Voltaic Battery, Portable. J. Mackenzie, Osnaburgh St., County of Middlesex, England.

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270,639 Clock, Electric Alarm. J. I. Conklin, Jr., New York, N. Y.
270,778 Electric Battery, Secondary. W. K. Freeman, Brooklyn, N. Y.
270,735 Electric Lighting for Railway Trains, System of. C. E. Buell, New Haven, Conn.
277,779 Electric Machine, Dynamo. W. P. Freeman, New York, N. Y.
270,780 Electric Machine, Dynamo. W. P. Freeman, New York, N. Y.
270,781 Electric Machines, Armature for Dynamo. W. P. Freeman, New York, N. Y.
270,777 Electric Machines or Electric Motors, Armature for Dynamo. W. K. Freeman, Brooklyn, N. Y.
270,734 Electric Storage and Supply, System of. C. E. Buell, New Haven, Conn.
270,703 Galvanic Battery. G. Scrivanow, Paris, France.
270,806 Lamp, Electric. W. F. Jobbins, East Orange, N. J.
270,725 Lamp, Electric-arc. G. W. Beardslee, Brooklyn, N. Y.
270,676 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
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270,848 Telegraph, Mechanical Speaking. A. M. Rosebrugh, Toronto, Ontario, Canada.
270,774 Telegraphs, Perforator for Automatic. T. M. Foote, Brooklyn, N. Y.
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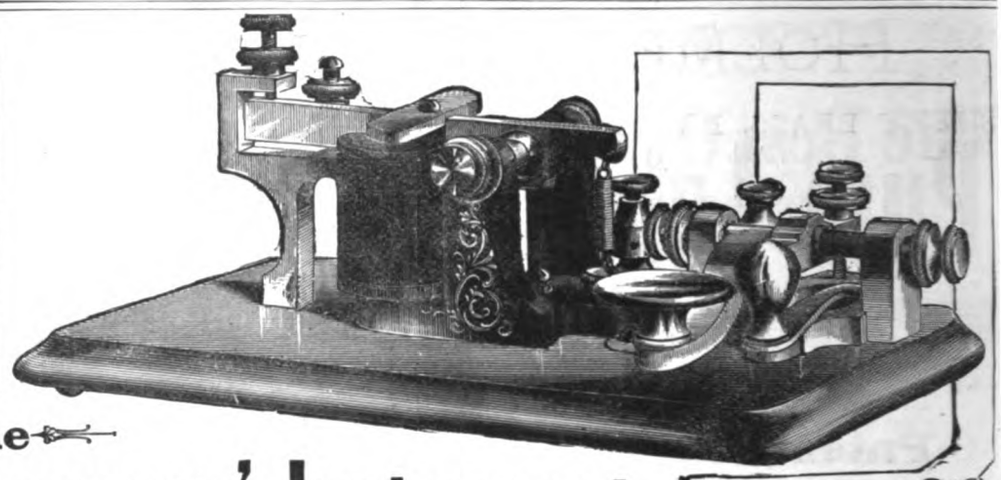

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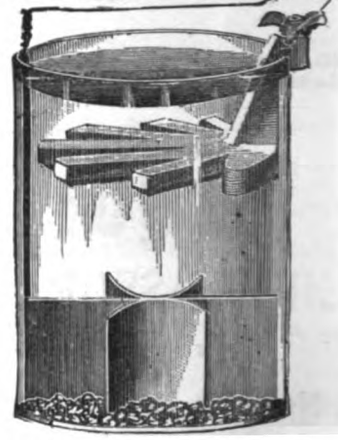

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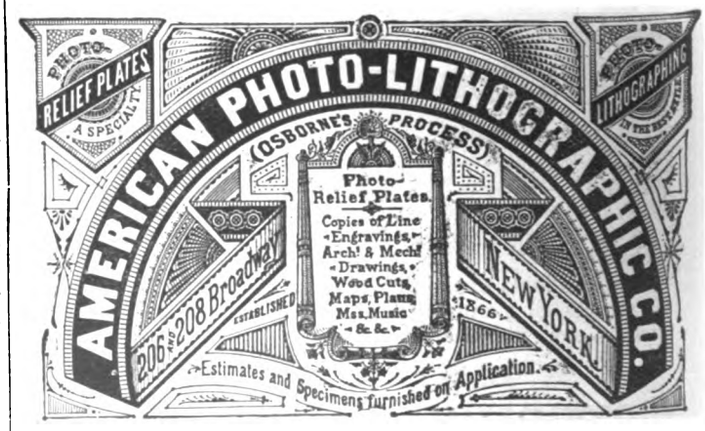

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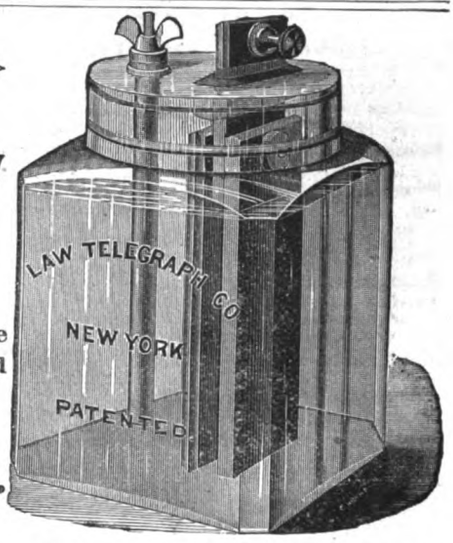

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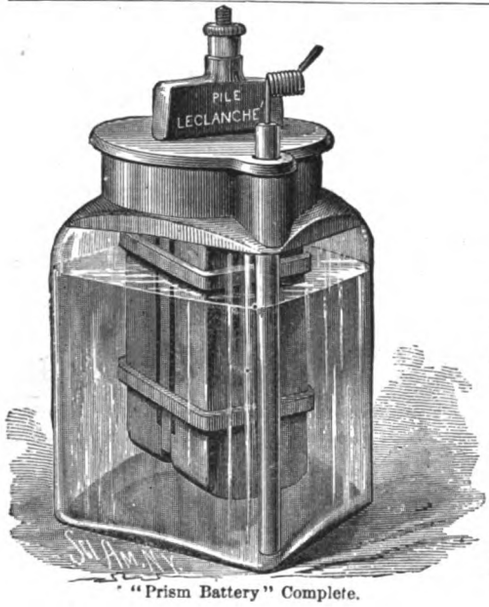

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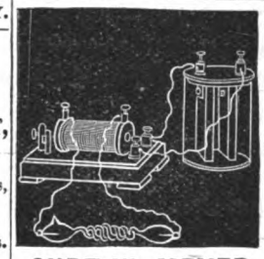
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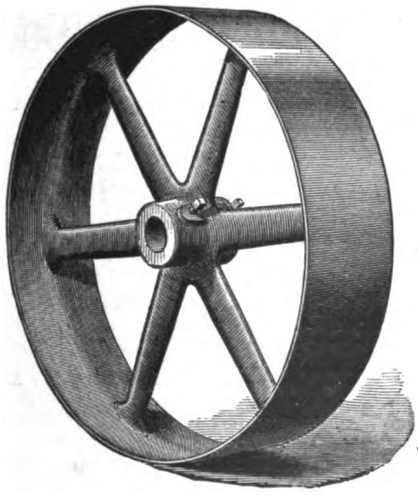
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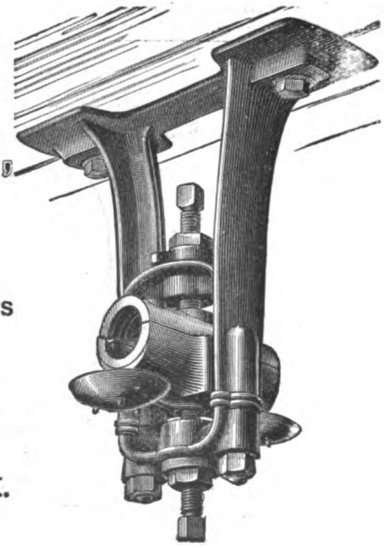

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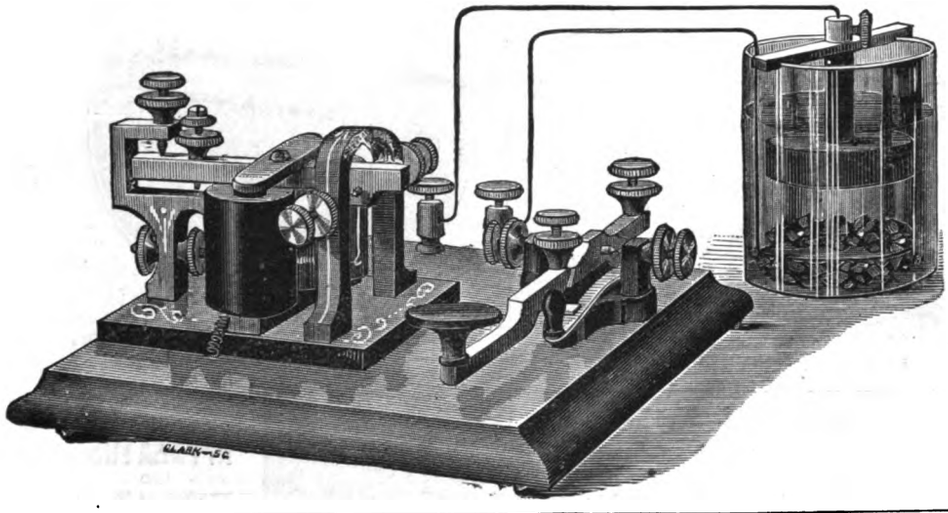

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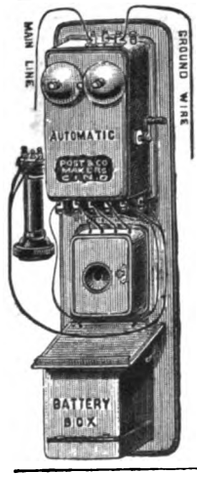

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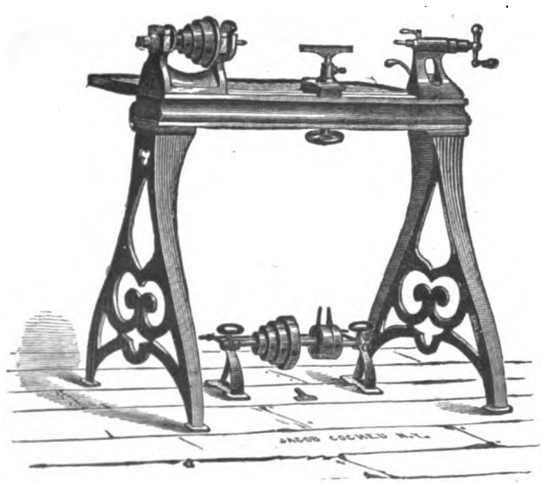

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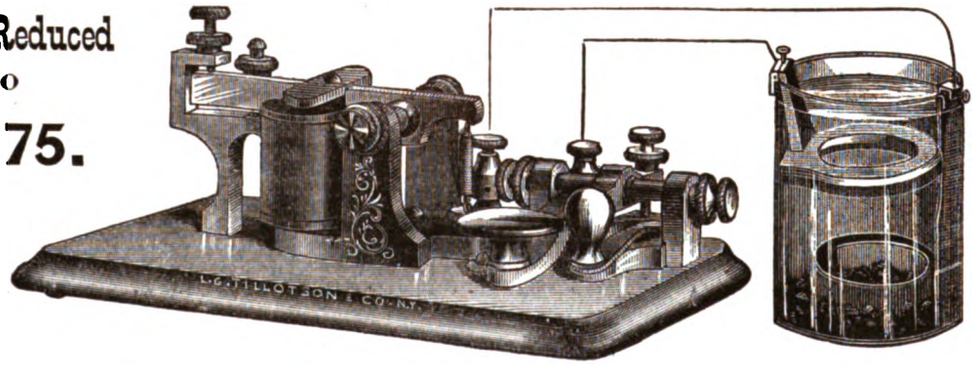

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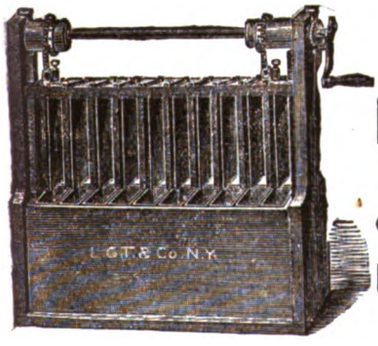

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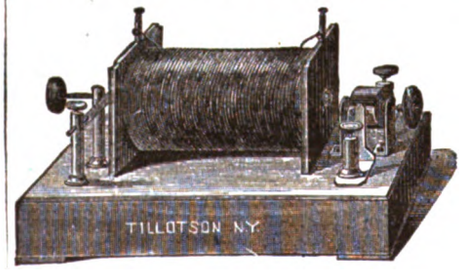

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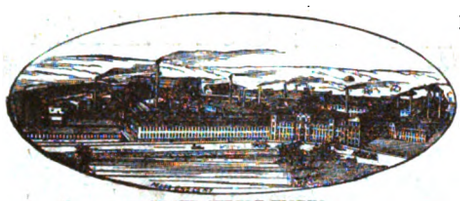

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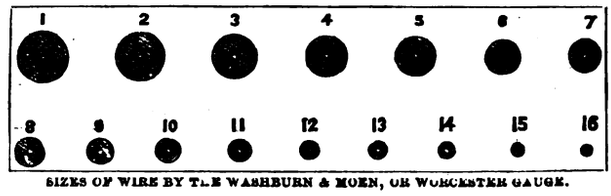

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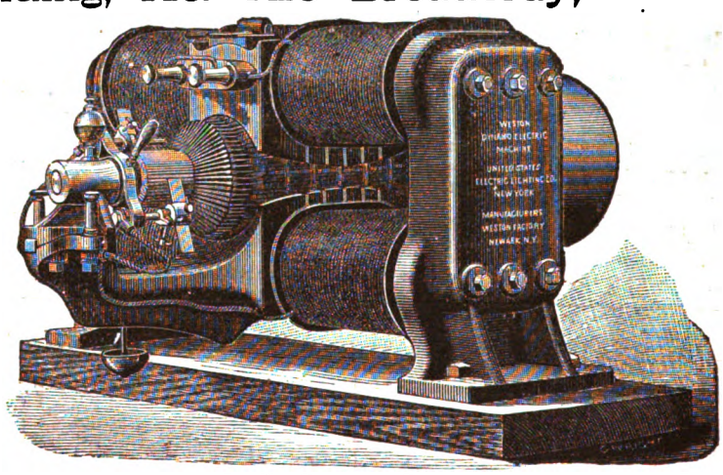

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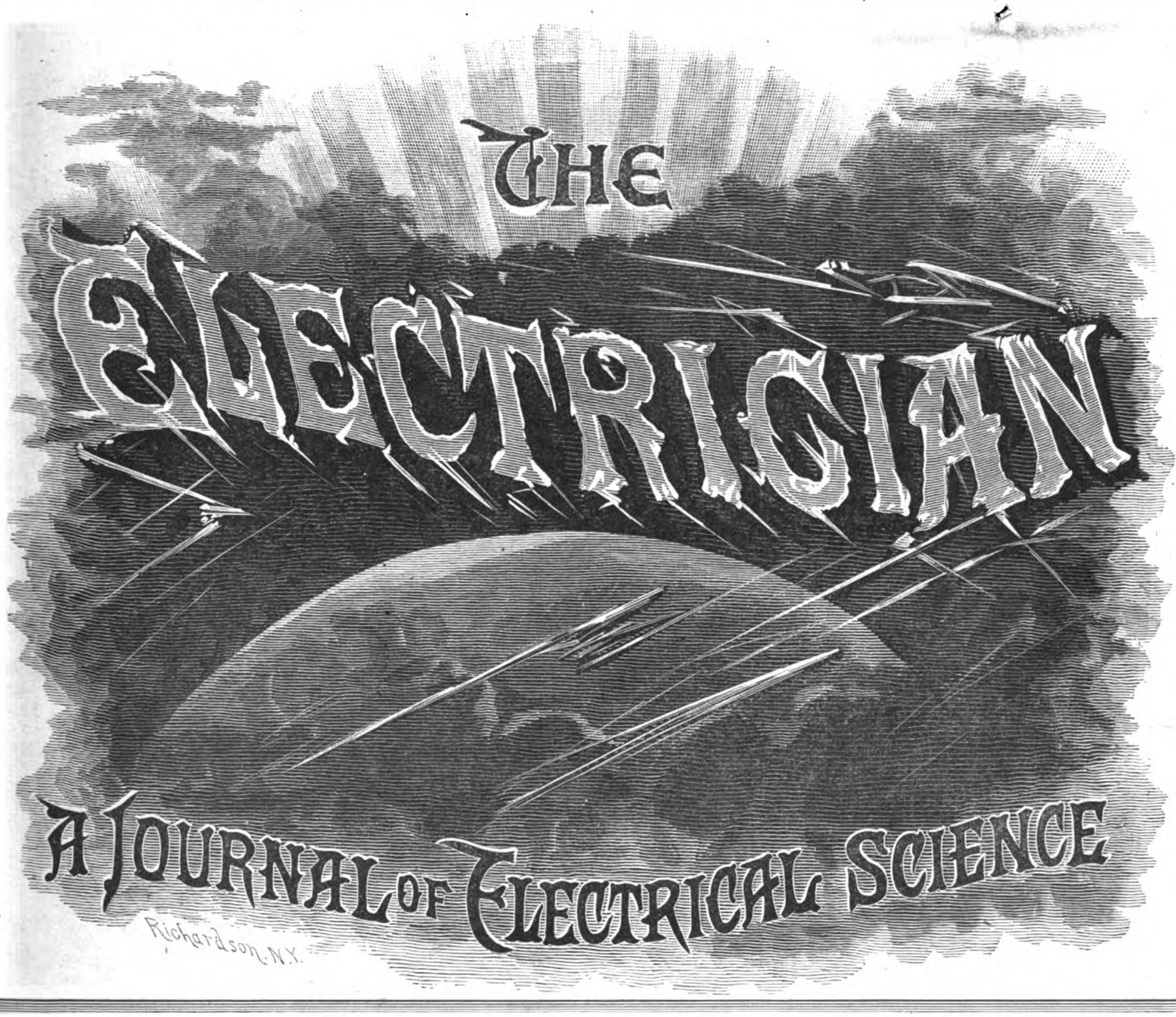

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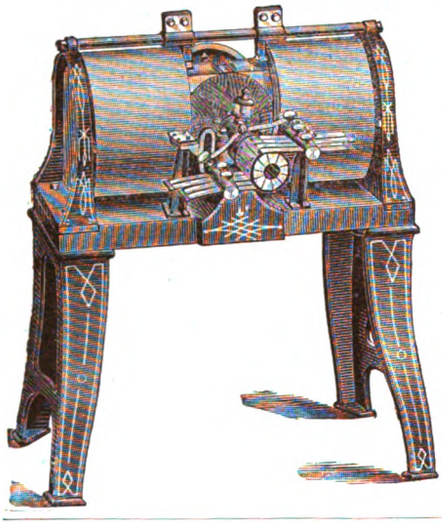

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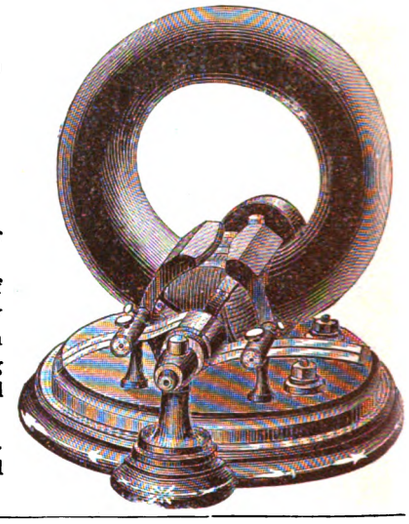

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THE ELECTRICIAN.

Vol. II. No. 3.] MARCH, 1883. [$1.00 a Year. 10 Cents a Copy.

CUT-OUTS FOR ELECTRIC LIGHT WIRES.

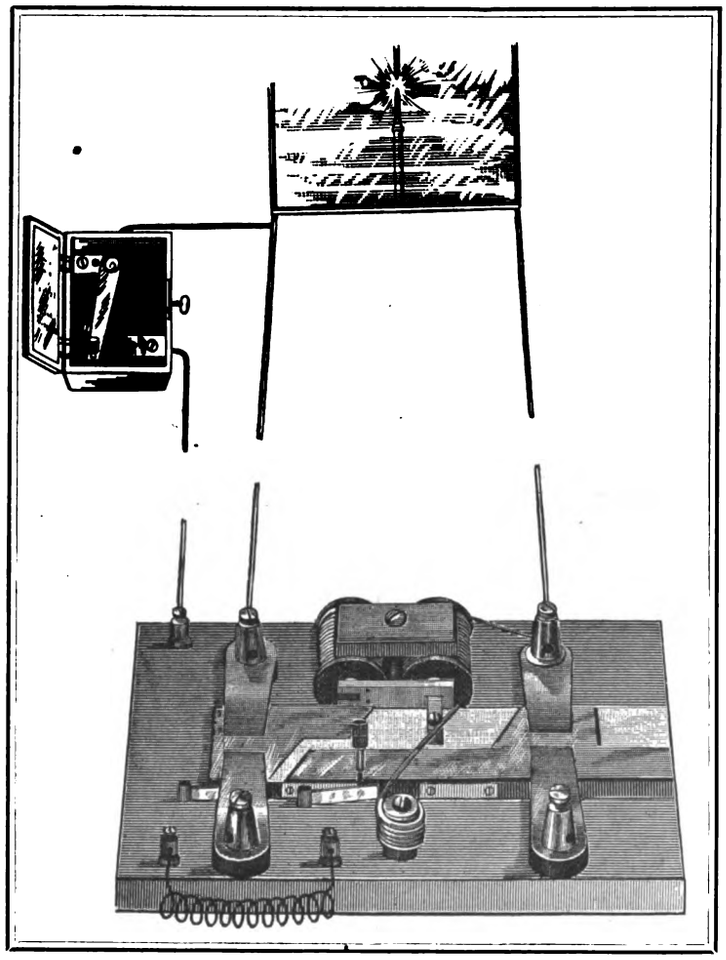
THE matter of a cut-out for electric lighting wires, is a question of admitted desirability, but there have been difficulties in its application.

The electric lighting companies need a cut-out, the same as gas, and water companies need shut-offs, to control the supply to individual customers, if need be; and in case of accident or alteration, a cut-out forms a safe and easy way of removing the current from a building. The insurance interests, without exception, call for a cut-out for use in times of emergency, at or near the entrance to buildings using electric lighting apparatus.

To conform to these various requirements, the wires must be brought down the front of a building, or a loop brought near to the entrance. In any event, the cut-out only partially remedies the difficulty, inasmuch, that the wires from the fixture to the cut-out are still charged with electricity.

The illustration shows the cut-out invented by Messrs. Bosworth & Swan, of Boston, in which some very commendable features are introduced Instead of being near the ground, it can be placed at any point in the circuit, preferably at the fixture on the top of the building. This cut-out consists of a sliding switch, made of marble, against which a spring presses. In the middle, a latch is fastened to the armature of an electro-magnet, so that when the circuit is closed, the magnet draws down the latch which releases the spring, and throws the switch. The connections are all lapping, moving parts—are all lapping connections—so that no arc is formed when the switch is used. It can be used in connection with a resistance in such a manner, that when the cut-out is used, and the lamps on any premises switched out of the circuit, an equivalent resistance is at the same time added to the circuit, thus preserving the external resistance at the dynamo uniform. The coils of the electro-magnet are in a loop from the main line, which is worked by a key or switch, in any convenient position.

It will be readily seen that this switch, in addition to other distinctive merits, can be used with less wire, than other cut-outs, which must be placed near the ground and at the front of a building.



CUT-OUT OF BOSWORTH AND SWAN.

—— ACCORDING TO THE *Journal* of the Russian Physico-chemical Society, the priority in photographing with the electric light belongs to the well-known St. Petersburg photographer, M. Lewitski, who obtained such photographs in the winter of 1856, on the following occasion:—To produce the electric light during the celebration of the coronation of the Czar, Alexander II., at Moscow, a Bunsen battery of 800 elements had been constructed. The following winter this battery was taken to St. Petersburg, and Prof. Lenz demonstrated its action to a distinguished auditory, formed of members of the Imperial family and generals of the army. It was during this lecture that M. Lewitski obtained a photograph of the professor. A positive of this portrait was presented by M. Lermantoff to the Russian Physical Society at the *séance* on December 14, 1880. It is by no means a poor photograph, but full of detail in the shadows and half tints.

—— TO GIVE AN IDEA of the price charged for the new accumulators (Faure-Sellon-Volckmar type), says an English paper, we may mention that one, consisting of 22 cells, capable of giving one electric horse-power, costs £79 4s. Its maximum charging capacity is 400 ampères, To always maintain the same E. M. F. (which in this case is 45 volts), about 25 per cent. of the electrical energy which the accumulator can receive must be allowed to remain.

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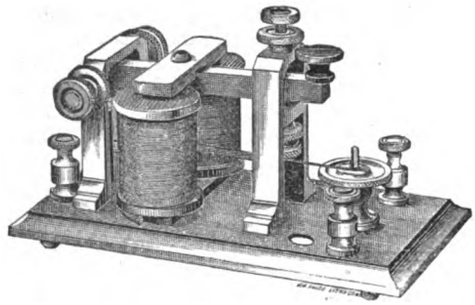
IMPROVED BURGLAR ALARM.

THE Improved Burglar Alarm, a cut of which accompanies this article, is the invention of Mr. Charles Temple Jackson, of this city. It presents some new features which are somewhat remarkable. It might, with propriety, be called a condensed burglar alarm. The advantages claimed for it are extreme simplicity, cheapness and certainty. It is quite small, not easily deranged, and working on the closed circuit, is more nearly an infallible detector of a burglar's presence than the older inventions.



Should a burglar open a window or door guarded by this machine, the ringing of the bell announces his presence; should he stealthily introduce a pair of shears and cut the wire, again the bell rings and keeps on ringing. It would seem thus to baffle the ingenuity of the most expert of cracksmen to evade its tell-tale sounding.

By an ingenious contrivance, Mr. Jackson has so arranged in addition that the entrance of the burglar, will not only cause the bell to ring, but will light the gas on as many burners and rooms as may be desired.

It is readily adaptable to either dwellings or warehouses; and its cost being very much less than its predecessors, it brings within the reach of many, who have heretofore looked upon a burglar alarm as an expensive luxury, an almost indispensable safeguard to these persons and property.

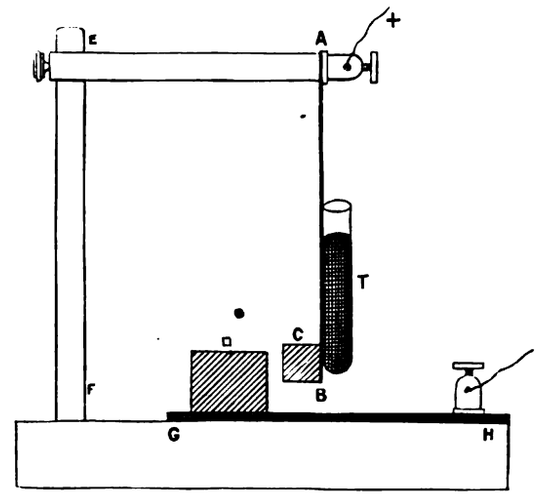
—— IN THE COURSE of a lecture at Leeds, England, on the Technical Application of Electricity, Prof. Rucker stated that some dynamo-electric machines converted not less than 97 per cent, of the work put into them into electric energy.

—— THE LONDON *Lancet* calls attention to some cases of lead poisoning amongst the workmen of an electric storage factory in the East-end of London. The "paste" is said to be made of a powder containing lead, which is mixed with strong sulphuric acid, and fumes are given off. Our contemporary suggests the use of masks by those who mix the paste, and of gloves by those who apply it to the plates

——THE WESTON ELECTRIC COMPANY, in Boston, have been supplying the electric light in Park Square for several months. The conducting wires are number four copper wire, covered with rubber, one-eighth of an inch thick, and protected by a double covering of cotton braid. These wires are laid in grooves in plank, which are placed three feet below the pavement, and covered by another plank, and the earth replaced as before. The resistance of the insulation of the system, is over 90,000,000 ohms for the conductors, as they are buried in the earth. This would be about 18,750,000 ohms per mile. The exact resistance of the insulation was not measured, because the apparatus was not capable of measuring over 90,000,000 ohms. This company conduct electric lighting currents, through submarine cables, from Boston to Charleston, and also to South Boston. Their experience has been so satisfactory that they have made an offer to the city authorities to light the public garden by means of arc lights, with underground conductors.

EXPERIMENTS WITH THE MICROPHONE.

THE following experiments were undertaken, principally for the purpose of ascertaining the origin of the "sputterings," which are produced by the microphone. They led, incidentally, to other results, however, which showed carbon transmitters from a new point of view. Mr. Hughes has his transmitters supported by elastic plates, and attaches great importance to this method. M. Ochorowicz, in an article published in this journal, showed the necessity of having the carbons in contact, at three material points at least, but he did not inform us what dimensions should be given these points. M. du Moncel has pointed out, that the mobile carbon must possess a certain inertia, to avoid this sputtering. I constructed the following apparatus, to ascertain the effects of the greater or less elasticity of the suspension springs, the nature of the contact surfaces, and the inertia of the mobile system.



A B is an elastic plate, which is fastened by a screw, to the end of a horizontal bar, *A E*: this blade has a carbon cube *C*. of 8 or 10 millimetres side, on one of its faces at the end, and on the other, a small, glass test-tube, *T*, containing a certain quantity of mercury. *A B* is thus a regular pendulum, and its length and momentum of inertia can be regulated as desired. The bar, *A E*, is supported by a vertical column, *E F*, along which it may be raised or lowered, and fixed by means of an adjusting screw. The column *E F* is fixed to a horizontal board, on which is pasted a conducting belt, *G H*. A square of carbon *D*, can be passed, by the hand, over this belt, and put in contact with the carbon *C*, so as to make a microphone. One of the two electrodes of the pile, end in *A*, and the other in *H*, and the circuit is closed when the carbons *C* and *D* touch each other. I then placed a watch at the foot of the column *E F*, and I listened to the ticking through a telephone, placed either in the direct circuit, or in the secondary circuit of an induction coil. By changing the length or thickness of the elastic plates, (I used watch springs), and increasing or lessening the inertia of the pendulum, by the mercury in the tube, I could vary the degree of elasticity at will. A few passages of a file on the carbons, changed the contact surfaces, and gave them all kinds of curves.

The final conclusion I arrived at, from my experiments, was: Whatever may be the elasticity of the springs, or the extent or nature of the contact surfaces, and the inertia of the pendulum, it is always possible to obtain good acoustic results from the telephone, on the simple condition "that the contacts be slight."

Although the term "slight contact" has not yet received a very precise definition, every electrician understands what it means. When two conductors exercise a feeble pressure on each other at their point of junction, the contact is usually slight, but we have only to increase the pressure to make the contact good, and this quite independently of the resistance or conductibility that the conductors may offer. In my apparatus, the value of the contact was simultaneously dependent on the elasticity of the spring, the inertia of the pendulum, and even on the extent of the sur-

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faces that I made tangent. If the spring was very thin, and the inertia very feeble, the carbon *D* might be pushed against the carbon *C*, so as to make the pendulum deviate sensibly from the perpendicular, without the contact ceasing to be slight. The conditions were very different when I poured mercury in the tube—the inertia increasing, the pressure became greater, and the contact better.

The phenomenon of sputtering appears, at first, to be subordinate to the mobility of the system; by increasing the inertia of the pendulum, we can always suppress them, but only momentarily. They reappear when least expected, unless the most minute precautions are taken to protect the carbon contacts from exterior disturbances and draughts.

The slightest shaking of the table, or even of the ceiling, produced the sputtering. The microphone seems to be as sensitive in this respect, as the surface of a bath of mercury, and it should be always placed on supports, that are protected from disturbance. These sputterings are also caused by air currents that are imperceptible to our senses. Placing the apparatus before a lamp, so that the contact, which was between my eye and the luminous focus, was perfectly visible, I found the sputtering very great, despite the great inertia given the pendulum. This was caused by my breath, for the sputtering ceased at once, when the pendulum was covered with a glass globe, but began stronger than ever when uncovered. It was evident that the heat of the lamp produced an air current, that was sufficient to shake the pendulum I placed an ordinary microphone in a box, and a lamp alongside, and listened at the telephone. As long as the box was hermetically closed, no sputtering took place; but they began when the lid was raised, lessening according as the lamp was removed.

These experiments prove, that carbon transmitters should be placed in tightly closed boxes, and these latter have solid supports. I thought that the case might have a layer of wadding or India-rubber, but experiments showed that the sensibility of the microphone was diminished; as the vibration of the wood serves as a mechanical transmitter, with relation to the action of the sonorous waves, between the origin of the sounds and the carbon contacts, and wadding, wool, etc., are absorbers of vibration

I found that the ticking of the watch varied according as the watch was lying on the table, or at the base of the pendulum, the sound being far stronger when the case of the watch was in contact with the carbon *D*. Substituting the watch for the carbon *D*, I put it in contact with the carbon *C*, the microphone being then formed by the slight contact of the carbon with the metal. The ticking then became extraordinarily loud. The vibrations of the metal are, in fact, then transmitted to the contacts in the most direct way.

To make a good microphone, we must try first of all to transmit the action of the sound waves to the variable contacts, so as to have a maximum return, and lose as little as possible. When the carbon *D* was taken away, there was transmission through the wood of the base. Every microphone has these two transmissions, in one shape or another. There is a third—the surrounding air. The wood should be of good quality, dry and sonorous; those used for musical instruments are the best.

When the watch is placed in contact with the mobile carbon of the microphone, the sounds heard in the telephone are very loud, because the vibrations are transmitted in the most direct manner. When the watch is placed on the carbon *D* very good results are still obtained, because the transmission is sufficient; but this is not the case when the watch is taken in the hand so as to separate it from the carbon by a layer of air.

If a small music box is placed on the case of a microphone, we shall hear something like an Italian organ in the telephone. I do not believe that this phenomenon can be explained by supposing that the microphone amplifies the sounds; it appears to me more rational to suppose that the acoustic result is better, because the method of transmission is more perfect.

In most of the microphone transmitters at present employed, the fixed carbons are on a board, called the diaphragm. I do not believe that such an arrangement possesses any great advantage, as thin boards are shaken whenever there is any great vibratory force, and this to the great detriment of the acoustic result. The table should vibrate without its mass being shaken. We all know that a board of suitable thickness will transmit sounds, but this transmission is far superior when it runs in the same direction as the wood fibres, and not perpendicularly.

If we apply the ear to the end of a long piece of wood, we can distinctly hear the voice of a person speaking at the other end, but this is on the condition that the molecular vibrations can be transmitted from one to another so as finally to strike the tympan. If we substitute the microphone for the ear we shall have the variable contacts affected in at least the same degree as that organ, and the sounds can be transmitted, electrically, to any distance.

These facts have led me to believe that the diaphragm is generally superfluous in a microphone. If it is to be retained at all, it should be mounted in such a way that the transmission can be made in the direction of the fibres.

Here, however, is an experiment which may be considered as conclusive: I placed a microphone on a mirror, some five or six millimetres in thickness, the fixed carbons being tightly screwed on. The microphone, which was placed on a table in the middle of the room, transmitted the words that were spoken, several yards away, in the most distinct manner. I then thought of having the mirror in a room give out the words, by placing carbon contacts on the edge, and covering the whole in the wood work of the frame. I covered the part of the mirror having the microphone with a cushion, and left the rest uncovered. I found that there was no perceptible change in the transmission. I then placed a second cushion on the uncovered part, and put a mattress over all. Even under these conditions, every word spoken in the room, was heard distinctly by a telephone in a room over one hundred and fifty yards away.

In this case the vibrations were evidently transmitted to the microphone through the flooring and the feet of the table, on which rested the screw heads of the carbons.—*La Lumière Électrique.*

EASILY TESTED LIGHTNING CONDUCTOR.

CONSIDERABLE attention has lately been drawn to lightning conductors, by the published reports of the Conference on the subject. It appears that the mere presence of a conductor, is not always sufficient to neutralize the risks attending an atmosphere highly charged with electrical energy. It is now contended, that after a few years the efficiency of a conductor may vanish, and what was once an efficient conductor may, under certain circumstances, become quite useless. This would easily arise from the earth, in which the conductor is embedded, having become dry. It is, therefore, found requisite to test conductors at periodical intervals. With the ordinary copper rods, the difficulty is to carry an electric current to the terminal, which is often fixed in positions where it cannot be reached. To obviate this expense and render a test easy, Dixon, Corbett & Spencer, of Commercial Road, have been engaged making and fixing a new conductor under the patent of Mr. Vyle. Inside the cable, is an insulated copper wire passing up the core. At the terminal, this wire is laid bare and soldered to the outer copper wires forming the cable, over which the copper terminal is fixed. At the foot of the stack of chimneys, or building to be protected, is fixed a testing box, inside which the strands are opened, the insulated wire being again laid bare and connected to terminal screws. The insulated wire, is also connected to the earth terminal, forming two circuits. When a test is required, all that is necessary is to open the test box and connect a Leclanché battery and bell to the terminal screws; and, if the conductor is perfect, the circuit will be completed to the top of the conductor and again to the earth, as shown by the bell ringing. The value of this invention has already been endorsed at Tynemouth by the award of a silver medal.—*Ironmonger.*

—— THE EDISON ELECTRIC COMPANY expect to form a local company in Brocton, Mass., with a capital of $100,000. The plan is to erect a central station provided with eight dynamos and six engines, and boilers sufficient to furnish steam for 400 horse-power. They propose to furnish power as well as light, and this feature would be of great use for the small irregular quantities of power used in many portions of the shoe manufacturing business, which is the principal industry in Brocton. The owners pay for wiring the building, and the company bring wires to the building, and furnish globes. It is proposed to invest $60,000 in plant, and leave a live capital of $40,000.

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A BRIEF HISTORY OF ELECTRICITY AND ELECTRIC LIGHTING.*

BY W. J. LANCASTER, F.C.S., F.R.A.S.

HAVING thought that a brief history of electricity would be of interest to our members, I have searched through some scores of volumes, old and new, and present the following, with the best wishes of this festive season. The first record I have to note relates to 4,500 years ago.

At this remote period of our earth's history, the Chinese were acquainted with the power possessed by loadstone, of attracting particles of iron. Whether they knew of attraction and repulsion we cannot tell, and nothing is recorded of any further knowledge of magnetism or electricity until some 2,000 years later, or 580 B.C., when Thales of Miletus, the founder of the Ionic philosophy, discovered that amber (electron), when rubbed, possessed the power of attracting particles of decayed leaves, pieces of straw, etc. Thales believed that amber was an animate body, and in fact, regarded the world as a living being, and that everything was derived from water. Again, another period of over 2,000 years elapsed without any important fact being recorded; when, in A.D. 1576, Robert Norman discovered that when a nicely poised needle was magnetized, the North end became apparently heavier, and the South pole had to be weighted to give again a true balance; hence the inclination of the magnetic needle was discovered by Norman. Some twenty-four years later, in A.D. 1600, Dr. Gilbert, of Colchester, wrote a small work, entitled, "Physiologia nova de Magnett et de Tellure magno magnete," in which he describes some new experiments, proving that other bodies besides amber had similar properties under like conditions. Among such substances he enumerates glass, resin, spars, gems, stones, sulphur, etc., and he first gave the terms North and South pole; also a theory accounting for terrestrial magnetism. Although Dr. Gilbert's work was received with enthusiasm, three-fourths of a century had nearly elapsed before anything worth recording took place; when, in 1672, Otto Guericke, in his work, "Experimentor nova Magdeburdica," announced his discovery of a machine consisting of a ball of sulphur, which, when rubbed by the hand, produced sparks of electricity. Three years later, in 1675, Sir Isaac Newton found that a glass globe was preferable to a ball of sulphur; and Sir Isaac also found that by rubbing a flat glass held a short distance above the table, small bodies on the table were lifted towards it. He also found that different materials used for rubbing produced different results; some causing a violent attraction, and others a weak attraction only. In the same year, 1675, Robert Boyle found that not only did the rubbed amber attract other bodies; but that when the amber was suspended, so as to move easily, the amber itself was also attracted by the body acted upon; in other words, that the attraction was mutual.

The 17th century closed without any further discovery being reported; and in 1729, Stephen Grey, a pensioner at the Charterhouse, after numerous experiments, found that bodies were either conductors or non-conductors of electricity, and he conducted a current through wet string, the first experiment, leading on to the establishing of telegraphs throughout the world. Four years later, in 1733, Dufay discovered that conductors were non-electrics; and that non-conductors were electrics. He also distinguished between positive and negative electricity. For several years after this period, attention was directed to the perfecting of the frictional electric machine, the most important additions being, in 1740, the prime conductor, by Boze, of Wittenberg, and the fixed rubber, by Winkler, of Leipsic. Just after this, in 1746, Muschenbrock, and his pupil Cuneus, of Leyden, were endeavoring to electrify a flask of water, which Cuneus held in one hand, while a chain from the machine dipped into the water. After the machine had been turned some time, Cuneus, in the act of removing the chain received a severe shock. This was the origin of the Leyden jar, and, as it was the first experiment proving that electricity could be stored, it may rank as the forerunner of all storage apparatus. One of the greatest discoveries about this time was that in 1749, of Franklin's, by which he obtained a parallel between lightning and electricity. After a considerable number of experiments with a large battery of Leyden jars, he, in June, 1752, during a storm, flew a kite having metallic points; with this and a key attached to the lower end of the packthread, and from this a silk cord attached to a tree, he obtained a considerable number of sparks; not until, however, the rain had saturated the thread. From these experiments Franklin invented the lightning conductor. From Philadelphia we must travel to Pavia, where, in 1775, Volta invented the electrophorus, in 1782 he made the condenser, and in 1799 he made his famous voltaic-pile. While Volta was at work in experiments in frictional electricity, at the neighboring town of Bologna, Galvani was making equally important experiments, but in an opposite direction. Thus, in 1780, Galvani discovered the contraction in a frog's leg, when the crural nerve was connected to a metallic support, and the electrical machine worked, at every spark he found a consequent contraction of the leg. In 1786 he obtained the same effect by the contact of two dissimilar metals, and after a great number of experiments, in 1791, he published a complete account of them, which led to a considerable amount of correspondence between Galvani and Volta; but the first to explain the true cause of the action in 1792 was Fabroni, of Florence, who enunciated the theory that chemical action was the sole cause. This theory was further confirmed in 1800–7, by Davy, who immediately had made a large number of cells, some 2,000 in all. A full and a most interesting account of these cells, and the then remarkable experiments and researches made with them, may be found in the "Bakerian Lectures," of November 20, 1806, and November 19, 1807; in the latter one, Davy foreshadows his discovery in 1809 of the electric light, which he obtained from two pencils of charcoal, each 1 inch long and $\frac{1}{4}$ inch in diameter; the spark obtained, when the points touched, was increased to an arc 4 inches in length by the separation of the carbon points; afterwards an arc of 7 inches was obtained in an exhausted receiver, and so intense was the heat, that, Davy tells us, not only were the charcoal points consumed, but also the platinum wire to which they were attached was melted and fell down in large globules; since that time only 70 years have elapsed, and it will be quite impossible for me to chronicle one-tenth of the discoveries and inventions made in this period of time. I shall content myself by simply pointing out the most important of the discoveries connected with electric lighting, leaving it to my readers to study the subject if they wish to know something of that force which is destined to occupy an important place in the near future.

A discovery, of the utmost importance, was made in the latter part of the year 1819, by Oersted, the then Secretary of the Royal Society of Copenhagen. He had, in 1813, published a work in which he hinted at a connection between magnetism and electricity, but it was six years later when he made the important discovery that a current of electricity passing through a wire over a magnetic needle caused the needle to deflect. The announcement of this experiment, excited the greatest interest among all the philosophers of Europe; and in 1820, Arago invented the electro-magnet; Schweigger, of Halle, also invented the galvanometer, which Ampère first exhibited at a meeting of the Royal Academy of Sciences, and in the following year, 1821, Faraday discovered electro-magnetic rotation; a full account of his experiments are contained in the *Philosophical Transactions* for 1823; but the most important of the great discoveries of the noble Faraday, was that in 1831, when he obtained electricity from the inductive action of terrestrial magnetism. In the year following, 1832, Pixii made the first magneto-electric machine, which was improved and added to, in 1833, by Saxton, of Philadelphia, who made the bobbins to rotate, in place of the rotating magnet of Pixii. Other improvements have been made; but one of the most important was that by Siemens, in 1854, of his armature, in which the wire was wound longitudinally instead of transversely, as in the old machines. The first time the electric light was used in a public manner was in 1836, when it was used to illustrate the rising sun in "Le Prophète," at the Opera, in Paris. How different to the magnificent effect of the electric lighting in the present Opera House. Four years later, 1840, the first patent (No. 8644), was taken out by Henry Pinkus, for electric lighting; a number of patents were granted year by year. In the year 1845, a patent was taken out by Starr and Peabody, for an incandescent lamp, consisting of platinum wire; and in 1847, Foucault and Duboscq made the first regulator for an arc

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light; soon after this, Serrin made his famous regulator; this entirely superseded the former one of Foucault and Duboscq. In 1849, Professor Nollett, of Brussels, commenced a machine, which was not finished during his lifetime, but was afterwards completed by Berlioz and Melderen. This machine, called the Alliance, contained 48 compound magnets, and when the armature was rotated, a brilliant light was obtained; but this machine, although used at that time in several lighthouses in France, was soon replaced by smaller and more perfect machines. In 1854, Siemens made a great improvement in the armature, which I have before mentioned; then came the machines of Wilde, Holmes, Ladd, and others, and during a period of some eighteen years, but little was done to keep up the excitement of 1840–6; but in the year 1872, Gramme made his justly celebrated dynamo, which has yielded him fame, gold medals, and other rewards, and as a consequence of his success, others followed, and some hundreds of dynamos have been made—some good, others bad—and among other inventions connected with electric lighting, is that in the year 1876, by Jablochkoff, of the candle which bears his name; also, in 1878, Edison introduced his platinum incandescent lamp; again, in the same year, Brush made his famous dynamo and arc lamps; and in 1881, Maxim made his incandescent lamp, using carbonized cardboard. Lane-Fox also made an incandescent lamp, using carbonized broom, Edison's using carbonized bamboo, and Swan, who uses carbonized parchment, and in the same year, amid considerable puffing, Faure's accumulator came on the scene, and remains almost as it was. But there are reasons why the accumulator should become a great success; and with the amount of brain energy devoted to it, we shall, no doubt, during 1883, have a more perfect accumulator. It has been impossible to mention even the names of the numerous systems of electric lighting, but I have to mention a system which has occupied considerable attention, and which has been most successful where adopted. I refer to the 1882 Crompton system of electric lighting, of which the Crompton Winfield Association are the proprietors. The association manufacture the Crompton electric arc lamps, Bürgin dynamo machines, electric mains, electric lanterns, and all kinds of ornamental fittings, for use in electric lighting. Beginning with the Bürgin dynamo, which is a recent introduction into England, I may state, that although at first it was an excellent machine, still Mr. Crompton has so much improved its construction, that it is now known as the Crompton-Bürgin machine. The current produced by it is a continuous one, equally applicable for either arc or incandescent lamps, and its current being, as I have stated, continuous, there is no danger of even the slightest accident, or even death, as is the case with an alternating-current. The dynamo consists, essentially, of a large pair of electro-magnets, forming the framework, having similar poles in close contact thus, N. to N. and S. to S. Between the N. and S. poles, a space is bored out truly cylindrical, and is fitted with gun-metal covers, having central bosses, in which revolves a turned steel spindle, driven by a steam engine. Upon this spindle are secured, side by side, but in moderately open order, a number of coils of insulated copper wire, so disposed, that when revolving with the spindle, the rings of each coil cut through the lines of force of the electro-magnets, and induce a current of electricity, becoming more intense, in proportion to the number of layers of wire in each coil, and also to the speed of rotation. The coils are built on radial arms from the spindle, as to bring them as nearly as possible to the inner surfaces of the pole pieces of electro-magnets when rotating, so that the whole cylindrical space is lined with the coils. From each coil there are two free ends of wire, all of them being led out to one end of spindle; they are there connected to separate insulated strips, forming the commutator; the current is collected from this commutator by a couple of metallic brushes, diametrically opposite to each other; these convey the current, first through the coils of wire on the large electro-magnets, called the field magnets, and thence to binding posts, from which a cable conveys the current to be used up, either as an illuminant, or as a source of power. For an arc light, a regulator must be used, and for incandescent lighting either of the systems I have before mentioned is satisfactory. In the lighting of our own institute, the Crompton Winfield Association use Swan's lamps, of which there are over 40 in the circuit; these incandescent lamps are very satisfactory, and have an average life of 1,000 hours; some, however, have lasted longer than this. Of the fittings, I can only say that the beauty of Messrs. R. W. Winfield and Co.'s productions is well known, and they have, not only here, but in the Town Hall, Birmingham, the Mansion House, London, the New Law Courts, etc., etc., added lustre to a reputation already world-wide and unsurpassed. I have only to add that Messrs. Winfield and Co. will be happy to show, at their own offices and show rooms, their contributions to practical electric lighting, to anyone interested in the subject.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

THE following condensed report of the meeting of the above Society, on the 18th of January, we take from the *London Electrician*, of January 27th. The president, Mr. Willoughby Smith, read his inaugural address:

After referring to the youth of the society, and the great progress it had made during the short period of its existence, a circumstance which was to be ascribed, not to any long line of illustrious names which some ancient societies could boast of, but to the rapid growth of electrical science, and extension of its application to practical affairs, which had taken place during the past ten or eleven years. Mr. Smith went on to show that every branch of science has progressed, in proportion to the accuracy and delicacy of the appliances with which they have to work. And this was true of no branch of science more than of that in which telegraph engineers and electricians were interested. Besides apparatus, however, there was also needed an exact system of measurements, upon which uniform and coherent calculations could be made. Some advances had been made in these latter respects, by the adoption of electrical units; but a good deal still remained to be done, and it was to be hoped that the Paris Electrical Congress, which had adjourned till the end of the present year, would by that time be in a position to unanimously agree upon standards, which would be at once practical, international, and reliable. To the practical electrician—and Mr. Smith confined himself throughout to practical matters—the material was the important thing, not the definition or the nomenclature. For example, it was possible to buy copper wire of higher standard, than the one authoritatively recognized, the characteristics of so-called pure copper wire differing greatly with the place of its manufacture. This was shown by the results of tests of five samples of pure copper, of same length, gauge, and temperature, which showed that their specific conductivity was a long way from being uniform. Mr. Smith then dealt with the subject of dielectrics, with which he had had a great deal to do, in connection with submarine cables. Here, again, the change, or original difference of material rendered mere definition of hardly any use. Difference in age and temperature completely alters the characteristics of the insulator. Resistance of the gutta percha, for example, increases with age, as shown by a table of tests taken over a succession of years, the increase in some instances being nearly threefold. Again, it was more and more evident, that a constant electro-motive force should be at our disposal for electrical measurements. Much, no doubt, had been done in this direction, but it was still a fact, that no battery had yet been devised, whose constancy could be maintained and depended upon for any length of time.

Amongst the many discoveries that had remained idle and unserviceable for years, Mr. Smith supposed he must include that of the peculiar properties of selenium, with which his own name was associated. At one moment expectations had been raised as to its utility in connection with the photophone; but he had been skeptical about this from the first, and events had shown that the effects were not due to the use of selenium, but were common to other substances, and attributable to radiant heat rather than to light. Nevertheless, he was sure that some work was to be got out of this metal, for where light was absorbed, as was the case with selenium, work was capable of being performed by it. In connection with this matter, some experiments he had made with various kinds of light, from an ordinary candle to that of an electric light, were of interest. A selenium cell being placed in circuit with a galvanometer, it was found that the rise and fall consequent upon the change of light, although very marked, were not completed all at once, the rise being followed by a slowly succeeding and further deflection, the fall by a gradual further decline. This showed that the absorption and giving out were not instantaneous, but occupied an appreciable time.

Turning to the subject of earth currents and similar phenomena, Mr. Smith observed, that so soon as "earth" was used for the return current, as it was then called, on telegraph lines, magnetic disturbances were observed, and gave much trouble. To the present day we had not, by any means, eliminated this disturbing element. But some useful results might follow therefrom if it induced us to establish points of observation, as

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had been done in respect to terrestrial magnetism; to take note of and collect statistics as to earth currents, their strength, their direction and duration. If we could, so to speak, link the aurora to terrestrial magnetism, and this again to earth currents, how much more easily might we then be able to link together many other natural phenomena in one and the same chain!

After sketching the adaptation of the magnet to various electrical uses, Mr. Smith pointed out that we were now engaged in obtaining powerful magnetic fields, especially for electric lighting purposes, but that we had not yet arrived at certainty, as to the quality of the iron to be employed or the best way of applying the wire. Illustrating this latter point diagrammatically, the best position could be shown by sliding a secondary coil, to which a galvanometer was connected, along a primary coil in the form of a bar electro-magnet The deflections would thus be shown to be greatest when the lines of force cut the secondary coil at right angles. As regards the metal employed, his experiments, which had already been published, were here illustrated. Two flat spirals facing each other some distance apart, and connected with reversers, were separated by the metal plate to be tried. The results were very curious, and depended not entirely upon the character of the metal, but upon the speed of the reversals. Copper was unable to intercept the inductive effects between the two spirals when the reversals were slow; whilst iron was uniform, or almost uniform, irrespective of speed. The same was true of lead; but zinc and tin varied the induction with every variation in the speed of reversals.

Some defects in our present system of protecting buildings from the effects of lighting were dealt with next, and the hope expressed, that as the use of electric light and power became general, the care of lightning conductors would fall into the hands of more competent men. With regard to electric lighting, the chief defects noticeable at present were the frailty and impurity of carbons, and the insecurity of insulation. As to the former, their manufacture goes on steadily improving, and, in regard to the latter, experience was teaching its useful lessons every day. Metals, it was suspected, fuse most easily when a current is passing through them, and, as the temperature alters the resistance, the insulator is subject to an increasing liability to destruction the longer the current remains on. The unprecedented demand upon the resources of electrical engineering had for a time caused inexperience to step in where experience feared to tread; but this danger is now rapidly disappearing. One other drawback felt at present is the want of a good system of photometric measurements, the eye not being trustworthy for so delicate an operation.

The storage of electricity was, of course, a great *desideratum*, and backed by the name of one who stood very high in the profession, a secondary battery of extraordinary pretensions had raised expectation to the highest. But two years have passed away without any useful result following the importation from Paris of that marvellous box; and in the interval, experiments had not proved favorable to this class of battery. The difficulties of storage, though probably not insurmountable, have yet to be overcome. When submarine cables were first projected, all sorts of imaginary difficulties and dangers were conjured up against them, but they have triumphed over all obstacles, and he, Mr. Smith, believed that in like manner electric lighting enterprise will achieve a great success. After some brief references to the postal telegraphs, the telephone, and the microphone, Mr. Smith concluded with an earnest appeal to students of electricity, both theoretical and applied, not to be in a hurry to make a market of their talents, never to be ashamed to confess ignorance, always ready to listen to those who can teach; and, as to the rest, learn above all things to "labor and to wait" for that reward which, sooner or later, comes to every honest and patient worker.

A vote of thanks, and a request that the address be printed in the society's *Journal*, having been proposed by Professor ADAMS, and seconded by Mr. SPAGNOLETTI, it was carried unanimously.

THE SEPARATION OF METALS BY ELECTROLYSIS.

TO obtain accurate results, the methods recommended must be carried out most exactly. For the determination of cobalt, an excess of neutral potassium oxalate must be added, but as the oxalate is gradually decomposed by the current, cobalt carbonate is deposited with the metal; this precipitate must be removed by cautious addition of oxalic or sulphuric acid. The deposition of the metal is, however, more rapid if ammonium oxalate replaces the potassium salt, but no more should be added than is necessary to form the soluble double salt. There is deposited with the metal, a red insoluble oxide which is but slowly reduced; to prevent this, the liquid to which an excess of oxalate has been added is heated, and a further addition of 3–4 grams of solid salt is made. The cobalt forms a grey adhesive coating, which must be well washed with water, alcohol, and ether, and then dried at 100 degrees. Nickel is estimated in a similar manner. In the determination of iron, the chloride or sulphate, with excess of ammonium oxalate, may be used, and in the reduced state it does not readily oxidize. Zinc, separated as above, adheres firmly to the electrode, and cannot be removed by dilute acids, but can be detached by heating the capsule to redness, and treating the residue with fresh acid. The precipitation of manganese is complete only when but little nitric acid is used; the presence of potassium oxalate causes separation of the peroxide, and this oxide is not firmly attached to the electrode, so that it must be separated by filtration, and converted by heat into Mn_3O_4. Ammonium oxalate must be added to bismuth nitrate solution, but some peroxide is formed which is but slowly reduced; great care in removing all water by alcohol and ether must be exercised, so as to prevent oxidation. The electrolytic deposition of lead cannot be recommended. Copper separates from an ammonium oxalate solution with great ease and accuracy. Cadmium forms a grey coating, which, although not adhering firmly, can be removed without loss if washed cautiously. Tin separates from the solution of chloride or oxalate as a fine grey coating; antimony separates as a fine light grey firmly adhering precipitate, from solutions to which sulphuretted hydrogen has been added. If the solution be acid, ammonia, or ammonium, sulphide in excess, is added. Ammonium sulphate accelerates the reduction. Arsenic cannot be separated quantitatively. Iron and manganese can only be separated if the formation of the manganese peroxide is prevented until the greater part of the iron has been precipitated. The presence of ammonium oxalate affects this result. If the oxalate has been decomposed before the end of the precipitation, and this is shown by the formation of a pink color, heat must be applied, and three to four grams of oxalate added. If the quantity of manganese is small, it appears as peroxide at the positive electrode, but if the proportion of manganese is double that of the iron, then the peroxide must be dissolved in oxalic acid, without interruption of the current, so as to effect complete separation The precipitation of manganese from the solution of oxalate as peroxide is not quantitative; therefore, the liquid, holding the greater part of the maganese peroxide in suspension, must be boiled so as to decompose the ammonium carbonate, and then neutralized with nitric acid, after which the metal must be precipitated as sulphide. Iron and alumina are separated so long as the ammonium oxalate is in excess of the carbonate formed by electrolysis; as in the previous cases, an excess of oxalate (three grams per 0.1 gram oxide) is added to the solution of the double oxalates, and the mixture is electrolyzed whilst hot. If the alumina is in excess of the iron, the same precautions must be taken as in the case of manganese.—Abstract of paper by V. Francken from *Journal of London Chemical Society*

PROF. TYNDALL ON LIGHT AND THE EYE.

IN our last number, we gave a condensed report from an English paper, of Prof. Tyndall's first two lectures, in London, on the above subject; we now take, from the same source, an abridgement of his fifth, and concluding lecture.

In his fifth lecture on "Light and the Eye," Prof. Tyndall proceeded with his illustrative experiments on the spectrum. He made it first fall from Thollon's prism, on a screen of red flannel, the result being that all the prismatic rays were quenched, except the red. What had become of the rest, it was asked. They had not been annihilated, for, throughout nature, nothing was ever lost. The missing light had been converted into heat. In like manner, when the prismatic rays were sent through a glass vessel filled with blue liquid, all of them vanished from sight save the blue, which was slightly tinged with green. The rest had been changed into heat. But the spectrum extended in both directions, beyond its visible limits. Beyond the visible red, they had rays of high heating power, though incompetent to exhibit themselves to the sense of sight; beyond the violet they had a vast body of rays, which, though feeble as regards heat, and unable to give light, were of the highest importance, because of their capacity to cause chemical action. In the case of the electric light, the energy of the non-luminous calorific rays emitted by the carbon points, was about eight times that of all the other rays taken together. It was possible so to sift either the solar or the electric beam, as to intercept its

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luminous rays, while allowing the non-luminous rays free transmission. This was demonstrated experimentally. The beam was made to pass through a solution of iodine, in front of the lamp, when the central bands of the spectrum were first cut out, and, by transmission through another solution, the whole spectrum was quenched. But the substances which thus eliminated the light, allowed free passage to the rays of heat. To show this, the beam was made to converge in the dusty particles of the theatre, by means of a plano-convex lens. The heat present at the focus was at once detected by the needle of the thermopile. The heat of the dark rays having been intensified by means of conjugate mirrors, it was proved by various experiments, that paper and wood could be kindled by it, non refractory metals fused, and refractory ones, such as platinum, heated to whiteness. Platinum thus heated, rivaled the brilliant magnesium light. It was proved, in this way, that non-luminous calorific rays might thus be transformed into luminous ones, yielding all the colors of the spectrum. This passage from the non-luminous to the luminous condition, by the intervention of a refractory body, is termed calorescence. But the audience was reminded of the extension of the spectrum, beyond the visible portion side of the violet also. These other invisible rays, when allowed to fall on certain substances—the disulphate of quinine, for instance—rendered these substances luminous, and were thereby themselves rendered visible. This change is termed fluorescence. Many beautiful experiments, illustrative of this subject, were performed. The phenomena of phosphorescence were next illustrated, mention being made of Balmain's luminous paint, and of more or less unsuccessful attempts to prevent colliery accidents by the introduction of phosphorescent lamps. A phosphorescent butterfly was greatly admired Passing to spectrum analysis, Dr. Tyndall remarked, that metals and their compounds impart to flames peculiar colors, which are characteristic of these metals, as was exemplified in the instances of mercury, thallium, silver, sodium, chloride of lithium, and chloride of strontian, the identifying bands of which substances were shown upon the screen. Hence, since we had acquainted ourselves with the bands produced by all known metals, new bands in the spectrum were proof of the presence of new metals in the flame. It was thus that the founders of spectrum analysis—Bunsen and Kirchhoff—discovered rubidium and cæsium, and that thallium, with the superb green band the audience had just seen, was brought to light by Mr. Crookes.

In the sixth, and concluding lecture, Thollon's vivid spectrum was again thrown upon the screen, and the lecturer then proceeded to illustrate, experimentally, the analogy between sound and color. A square disc of brass was made to give forth notes, whose pitch from the lowest to the highest was marked by the varying lengths of the lines caused by the vibrations of the sand strewn over the plate. These lines were termed nodal lines. The difference between a chorister boy s shrill voice and the bass tones of a man, was that the nodal lines left by the latter were longer. The air, which was the medium of conveying sound, might be compared with the luminiferous ether pervading all space; and in the spectrum, the luminous waves were found to lessen in length, in passing from the red to the violet ray. The ether's movements were undulatory, though the waves, like those of water in the chaotic foam of the Niagara Falls, a view of which was thrown upon the screen, might cross and recross in every direction. Newton's emission theory was first opposed by the celebrated astronomer, Huyghens, and the no less famous mathematician, Euler, and no scientist of any repute now upheld Newton's conception of light as an infinite number of projectiles impinging upon the eye. When tested by the facts, that notion had utterly broken down; whereas not one of the facts had been left unexplained by the undulatory theory. It accounted for all the phenomena of reflection; for all the phenomena of refraction, single and double; for all the phenomena of diffraction; for the colors of thick plates and thin, as well as for the colors of all natural bodies. It accounted for all the phenomena of polarization, as was shown experimentally, in the course of the lecture; for all those chromatic splendors exhibited by crystals in polarized light. Thousands of isolated facts might be ranged under each of these heads; the undulatory theory accounted for them all. It traced and illuminated paths through what would be otherwise the most hopeless jungle of phenomena in which human thought could be entangled. This was why the foremost men of the age accepted the luminiferous ether, not as a vague dream, but as a real entity—a substance endowed with inertia, and capable, in accordance with the established laws of motion, of imparting its thrill to other substances. It was Dr. Thomas Young, Prof. Tyndall reminded his audience, his own predecessor in the chair of Natural Philosophy in the Royal Institution, in the first year of the present century, who finally overthrew the emission theory. Young never saw with his eyes the waves of sound, but he had the force of imagination to picture them, and the intellect to investigate them. And he rose from the investigation of the unseen waves of air, to that of the unseen waves of ether, his belief in the one being little, if at all, inferior to his belief in the other. Young proved, that by adding light to light, darkness could be produced, just as by superinducing sound upon sound, silence could result. Light thrown on water was accordingly quenched, as the lecturer showed, by a beautiful experiment, when oil of turpentine was cast upon the surface. The explanation given was, that by the action, technically styled interference, the light reflected from the upper surface, deadened that reflected from the lower. Iridescence was illustrated by reproducing Newton's famous soap-bubble experiment, and the same philosopher's beautiful ring.

LOCOMOTIVE TORPEDOES FOR COAST DEFENCE.

LIEUTENANT C. SLEEMAN, R.N., delivered a lecture last week, in January, at a meeting of the Royal United Service Institution, on "Locomotive Torpedoes." The lecturer divided the submarine weapons known as locomotive torpedoes, carrying within themselves the power of locomotion, into two classes—first, the "uncontrollable" (those that cannot be controlled at the will of an operator); and, secondly, the "controllable" (those capable of being directed by the operator). In the uncontrollable class he placed the Whitehead fish torpedo, and he held that this was the most perfect torpedo of its class. The advantage of this weapon was that up to its limit of accurate range, 500 yards, it was entirely self-acting, and the vessel using it had nothing further to do with it when once it was discharged. Moreover, it had great speed, covering the 500 yards in 40 seconds. Its disadvantages were its limited accurate range, the complicated nature of its adjustments, and the necessity of discharging it from special apparatus. He mentioned that the German government had been making experiments with sunken batteries, containing several Whitehead torpedoes, discharged from the battery by electrical means under the control of those on the shore batteries, with the purpose of increasing the range of this torpedo, but he did not know what success had attended the experiment. He then dealt with the second class—the "controllable," and described the "Ericsson," the "Brennan," and the "Lay," the last-mentioned the invention of Colonel Lay. The first, he said, had been under trial in America, but the trials were not regarded as successful. The "Brennan" was an Australian invention, and had lately been under experiment at Chatham. This he described as a weapon moved ahead and steered entirely by mechanical means, those means being the connecting of the shaft of two drums placed in the body of the torpedo. These are made to revolve by fine wire reeled on them and connected with the directing point. The steering is affected by increasing or decreasing the velocity of either of the reels at the directing point. At Chatham a speed of 14 knots an hour was attained, and the weapon was controllable up to about 1,200 yards. The lecturer considered that the disadvantages of the weapon were many, while its advantages were few. The "Lay" then came under notice, and this was illustrated by diagrams. The weapon, which had been successfully experimented with in Russia and Belgium, was the only existing type of its class. It was constructed of steel, one-eighth of an inch in thickness, and was divided into three distinct sections—first, the bow section; secondly, a reservoir section, with the motive power, carbonic acid gas; and thirdly the after-section, containing the steering apparatus. The total length of the whole was 26 feet, its *maximum* diameter 24 inches, and it weighed, when completely loaded, 1½ ton. The amount of explosive carried in one type of the "Lay" was 90 pounds of dynamite, while the Russians had increased the charge to 150 pounds of that explosive. The charge could be exploded at will, or by contact. The lecturer described the controllable character of the "Lay" for its run of a mile and a half for harbor defense, or of three-quarters of a mile to a mile when used against a ship. He dwelt upon the value of this torpedo in harbor defence, and he held that the ingenious Nordenfelt submarine boat, armed with two of the "Lay" torpedoes, would make the successful attack on a harbor most doubtful. He also graphically and clearly described the "Lay" torpedo in ship attack and defence, and the advantages which a ship possessing the "Lay" would possess over a better armed vessel without this torpedo. He also pointed out the circumstances under which this torpedo would prove a most valuable factor in the defence of rivers, estuaries, and channels. Admiral Gore Jones, who opened the discussion, dwelt upon the inconvenience and danger arising in the "Lay" torpedo from the motive power arising from carbonic acid gas in the reservoir, and he stated, that in the earlier experiments the cable "kinked," and the experiments had to end. He contended that the use of the torpedo could only be limited. Colonel Gallway, R.E., dwelt upon the danger in a ship of carrying dynamite for the arming of the "Lay," and he questioned whether in practice in sea battles the "Lay" would have all the advantages claimed for it. Captain M'Clear, R.N., offered some observations, and then Mr. Nordenfelt answered some of the objections started by Admiral Gore Jones.—*Mechanical World.*

—— THE AMERICAN ELECTRIC COMPANY are to remove from New Britain, Conn., to Lynn, Mass., and occupy a new building with 30,000 square feet of floor. It is anticipated that their business will increase sufficiently to require 300 men.

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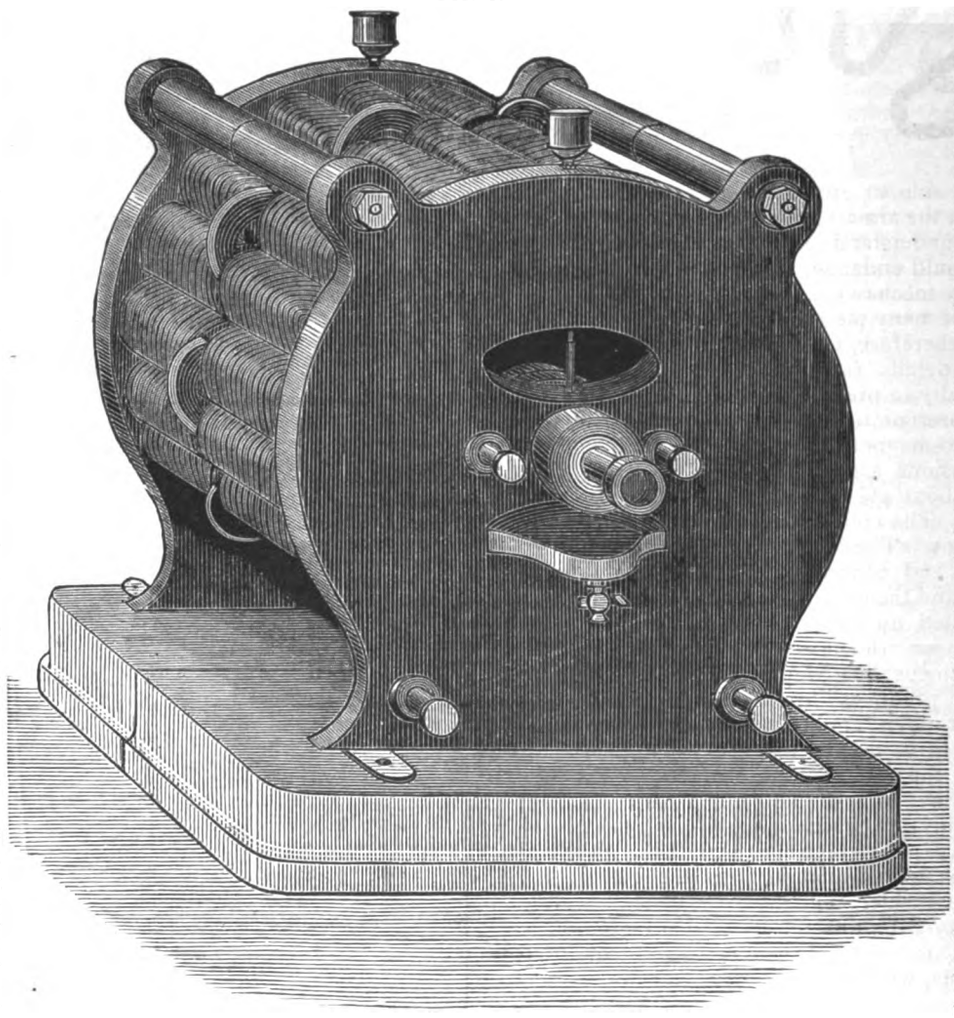
THE FERRANTI DYNAMO MACHINE.

SEVERAL new dynamo machines have recently been brought before the public in England, and have attracted much attention. Among these are the Ferranti, the Gordon the Dandeu and Chertemps, and the Elphinstone and Vincent machines, all of which, except the last, are of the alternating-current type. Of these, the Ferranti, or, more properly, the Ferranti-Thompson machine, appears to have attracted most attention, and the most extraordinary claims have been made in regard to its efficiency. After a careful examination of such data as are obtainable in regard to it, we are very far from sharing the great anticipations some of our contemporaries seem to entertain, as to the part which this machine is likely to play in the development of the different applications of electricity; and we must confess, that the highly sensational manner in which it has been placed before the public, leads us to accept, with extreme caution, such statements as have been made in regard to its performances, especially as these statements appear to have been founded largely upon mere guess work.

The Hammond Electric Light and Power Company, which appears to have had principal charge of the development of this invention, has been enabled, from its large experience in the exploitation of the Brush patents in England, to manage the advertising part of the business with extreme skill, and without very scrupulous regard for scientific accuracy of statement.

Before any definite information was given to the public in regard to the construction of the machine, paragraphs appeared in the press, announcing the invention, by Sir William Thompson and Mr. Ferranti, of a dynamo, startlingly novel in construction, and five times as efficient as dynamo machines then in use. Of course, the public generally took this statement to mean that the Ferranti machine was capable of producing a given result with one-fifth of the power required by other dynamo machines. Mr. Hammond was afterward compelled, when the absurdity of this result was pointed out, to explain that what he really meant was, that a Ferranti machine of given capacity, could be produced at one-fifth the cost of an ordinary dynamo of like capacity.

FIG. 1.



THE FERRANTI DYNAMO.

The first public exhibition of this machine appears to have taken place in the latter part of November last; and we reproduce the following description of the machine, from our able contemporary, *The Electrical Review*, of Dec. 2, 1882.

"Fig. 1 is a general view of the Ferranti dynamo-electric machine, and in a few words, it may be described as being made of a cast iron frame in two pieces, each carrying 16 electro-magnets arranged in a circle, with their poles within a short distance of each other, and having between them a revolving zig-zag shaped ring of copper ribbon, composed of 12 layers. The two ends of this continuous ribbon are connected—one to a ring attached direct to the axle supporting the armature, and the other to a second ring on the axle, but insulated from it. Two rubbers convey the alternating-currents to two terminals, shown on the outside framework of the machine. The small pulley at the end of the axle is for the purpose of connecting the machine

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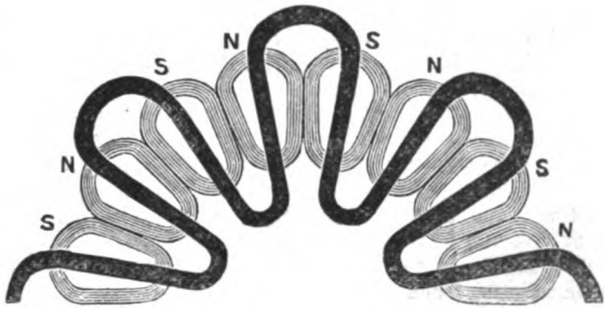
with a speed indicator. The electro-magnets are fed from a separate source; in this instance, from a small Siemens machine of the D⁶ type.

"The armature is partially shown in Fig. 2, as it appears with one side of the machine taken away. The length of the copper ribbon, which is wound continuously in a zig-zag shape, so as to produce 12 convolutions, is 120 feet. Its width is 12.5 mm., and thickness 2 mm., and its total weight 18 pounds. The convolutions are insulated, one from the other, by vulcanized fibre. The outside diameter of the armature is 21½ inches, and the mean diameter 15 inches. Its resistance is only .0265 ohms. From these figures, our readers may calculate the mean, or periphery, speed of the armature, which, at the time of our first inspection of the machine, was running at 1,900 revolutions per minute.

FIG. 2.



"We are not able to give the mechanical details of the manner in which the armature is attached to the axle of the machine, as we understand publication of this portion of the apparatus would endanger some of the foreign patents. Our readers of a mechanical turn of mind could, however, doubtless suggest many methods of accomplishing such an object, and we, therefore, fail to see the necessity for keeping back such details from the scientific press, whose endeavor is usually to present a *complete* description of any apparatus its representatives are invited to *publicly* inspect.

"The electro-magnets are alternately north, and their complete dimensions are as follows: Length, about 6 inches; depth, about 4½ inches; and diameter at widest part, 3¼ inches. The core of each magnet is wedge shaped, with rounded ends. The wire on each electro-magnet is 3.5 mm. in diameter, and consists of but four layers, weighing about 8½ lbs.; and the total resistance of all the 32 electro-magnets connected up in series, is 2½ ohms. The two lower terminals on the machine represent their ends. The small Siemens machine used for exciting these electro-magnets produces in them a current of 21½ ampères. Their poles are within ¾ of an inch of each other, so that a very intense magnetic field is the result. The height of the machine is 25 inches, and its base measures 24x22 inches. Mr. Ferranti informs us, that its total weight is only 11¾ cwt.

"This small and very compact apparatus, with the aid of the Siemens' 'exciter' (weighing about 2 cwt.), was producing the current which kept 300 Swan incandescent lamps in action at a *stated* luminosity of 20 candle power each. The lamps were arranged between the main conductors—which, by the way, were naked copper wires of one quarter inch in thickness—three in series, so that an electro-motive force of about 150 to 160 volts should be required for each set of three lamps, and a current strength of about 1.4 ampères. We are informed, that, in the absence of any but approximate measurements, the machine may be considered as having an electro-motive force, or difference of potential between its terminals, of 125 volts."

As will be seen from the above description, this machine is an alternating-current machine, and although quite simple and compact in its construction, it does not seem to us to present such startling features of novelty as its promoters have claimed for it. The arrangement of the field magnets is identical with that used long since in the Wallace-Farmer, and other well-known types of machines; and the absence of iron from the armature is certainly not new. The peculiar zig-zag arrangement of the armature conductors, is, we are inclined to think, an efficient one for machines of the alternating-current type, but we are not greatly impressed with its novelty. Figs. 3, 4, and 5, which we reproduce from United States patent No. 232,498, dated September 21st, 1880, to A. G. Holcombe, show a striking similarity to the cuts of the Ferranti machine, which we have given above, and the resemblance is not merely superficial. Indeed, the

FIG. 3.

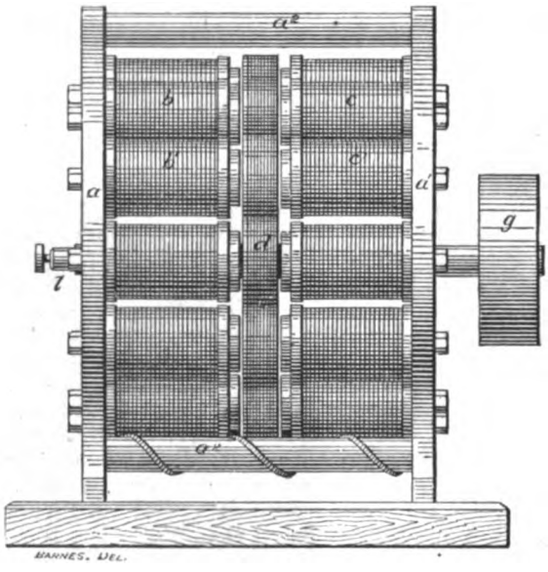


FIG. 4.

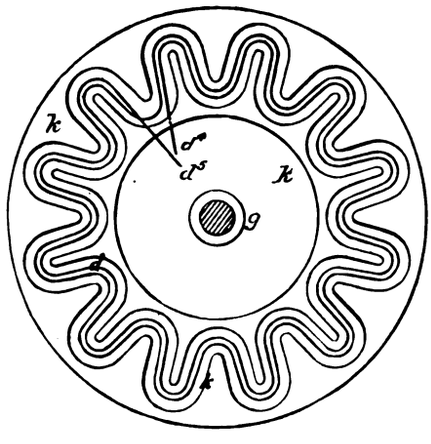
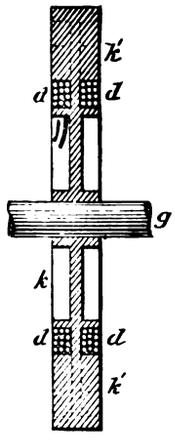


FIG. 5.



arrangement of the armature conductor, shown in Figs. 4 and 5, seems to be substantially the same as that adopted by Messrs. Ferranti & Thompson. It is stated in the specification, that "Fig. 5 (Fig. 4 above), shows another way of arrang-

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ing the conductor *d*, which consists of a disc K, provided with the continuous grooves K′ K′, one on each side of it, the principal lines of the grooves being radial. The conductor is placed in the groove by laying it all around against one side of it, and so following around the groove until the different layers completely fill it, as shown at Fig. 6 (Fig. 5 above), which is a transverse section of Fig. 5. The wires in the two grooves are then connected together, and the ends d^4 and d^5 connected to the insulated collars. By this method of winding the conductor, the greater part of it is caused to cut the lines of magnetic force at right angles. Consequently, for a given useful effect, less wire is required and the resistance is to such extent reduced." In another part of the specification it is stated, that the disc which forms the carrier for the armature conductor, is made of "a suitable diamagnetic material." Probably Messrs. Ferranti & Thompson have somewhat improved this form of armature in the details of mechanical construction; and the use of a flat copper ribbon instead of insulated wire probably presents some advantages, although we are inclined to think, from the published reports of experiments made with the Gordon machine, that this may also involve serious disadvantages, unless the copper ribbon is made quite narrow.

With regard to the efficiency of the Ferranti machine, no sufficiently trustworthy data appear, as yet, to have been made public to enable us to form an intelligent opinion. Some of the continuous-current machines now in the market, show an actual efficiency of about ninety per cent., and we do not think the Ferranti machine will go much beyond that figure, or even reach it; indeed, we shall be much surprised if any alternating-current machine equals in efficiency, the best generators of the continuous-current type. At the exhibition, to which we have referred, indicator cards were taken from the engine driving the machine, but no electrical or photometric measurements appear to have been made, and the statements made by those in charge, as to electrical and photometric results, can not be reconciled with the measurements of power.

On this point *The Electrical Review* says: "Since writing our description of the Ferranti machine which appeared in our last issue, we have been favored by Mr. F. C. Phillips, the managing electrician of the Hammond Electric Light Company, with a short table of data, giving the conditions under which the machine was working on the occasion of the public exhibition. * * * * which is as follows:

Current in main circuit	156	ampères.
Current in each lamp	1.3	"
Resistance of armature	.0265	ohms.
Resistance of external circuit	.7735	"
Total resistance of armature circuit	.8	"
E. M. F. total	125	volts.
E. M. F. for each lamp	41	"
Resistance of field magnets	2.5	ohms.
Resistance of exciting machine	.5	"
Resistance of exciting circuit	.3	"
Current in exciting circuit	22 5	ampères.

"As we mentioned last week, the indicated horse-power of the steam engine when driving the machine to produce the necessary current for 300 swan lamps, of 20 (?) candle power each, was 25.5. In a pamphlet, which was circulated on the evening in question, and descriptive of the system, the horse-power was stated to be *under* 26, and labeled on the walls it was given as 27. We will take as an approximate average, 26 indicated horse-power. * * * *

"According to Mr. Phillips' table, we obtain from the total electro-motive force and ampères combined, an expenditure of over 26 electrical horse-power; but with our modified figures, we cannot arrive at more than 23, whether by calculating on the basis of a single lamp or from the calculated external resistance of all the lamps. If, however, we could measure this external resistance, we should doubtless find the electrical horse-power still further reduced. Another point has yet to be considered. The engineer in charge of the Ferranti installation, Mr. Logan, informed us that the engine when driving the counter-shafting and the machines with *open circuits*, indicated *about* 7 horse-power. From this it will be obvious, that the amount of engine power taken up in *producing* the current for the 320 Swan lamps, would be considerably *lower* than the electrical horse-power quoted, were the figures for obtaining the latter result to be depended upon. We should imagine that no tests, of anything approaching an accurate nature, had been taken from the Ferranti machine—the fact of its being an alternating-current system would not, of course, tend to make such tests of an easier character—and it would appear, that its presumed efficiency has been simply calculated from the known data of a Swan lamp absorbing a certain current strength and at a stated candle power." We have awaited with interest the publication of more trustworthy data, but the results of such further tests as have been made do not appear to have been as yet given to the public.

A great point has been made of the low internal resistance of the machine as something quite remarkable. We do not think the figures given above warrant such a claim. It will be seen that the ratio of the armature resistance to the external resistance is about as one to thirty. Some of the best continuous-current machines now in use, show as low a ratio as one to forty, and we are informed that this ratio has even been made as low as one to sixty in actual practice. It will be observed, moreover, that the relative amount of work expended in exciting the field is quite considerable, and this ought to be taken into account in this connection, as it indicates that the comparative shortness of the armature conductor has been compensated for by a greater intensity of field.

As regards simplicity and cheapness of construction, the advantages presented by the Ferranti machine are more obvious, but we think they have been largely over-estimated.

Great stress appears to have been laid upon the comparatively small size and light weight of the machine. This does not seem to us to be, by any means, a controlling consideration, at any rate, within the limits which appear to have been reached in the machine exhibited. Reduction of weight does not by any means imply a corresponding reduction of cost. The greater part of the weight of an ordinary continuous-current dynamo, consists of the large masses of iron in the cores and pole pieces of the field magnets, and cast iron is very inexpensive. The only really expensive material used, is the copper forming the armature and field coils, and we doubt if the Ferranti machine is capable of producing as great results in current energy per pound of copper, as have already been obtained with well-known machines in common use. It should be borne in mind, moreover, that positive advantages, in economy, are secured by the use of large masses of iron in the field magnets, in enabling a very intense field to be maintained with very little expenditure of current energy, and these advantages more than counterbalance, as it seems to us, a considerable increase of size and weight. In the Ferranti machine exhibited, the comparative lightness of the field magnets appears to have been purchased at a considerable expenditure of current energy for exciting them.

Lightness of moving parts, however, is on all accounts desirable, and the extreme lightness of the Ferranti armature is a very commendable feature of the machine.

In considering the subject of simplicity and cheapness of construction, we must not lose sight of the fact, that a sep-

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arate machine has to be used to excite the field of the Ferranti machine, and the two machines taken together, should be compared with a continuous-current machine, capable of producing the same result. It appears to us extremely doubtful, if such a comparison would be as favorable to the Ferranti machine as is generally supposed, especially in comparatively small installations. The suppression of the commutator is a point of very great advantage in favor of alternating-current machines. Probably more trouble is experienced with the commutator of ordinary dynamos, than with all other parts of the machine put together; and with currents of the enormous volume, necessary for any general system of distribution, the problem of getting the current out of the machine without rapid deterioration of the commutator and brushes, becomes an extremely difficult one to solve. It would be extremely desirable to obviate this difficulty entirely, by doing away with the commutator, but we venture to predict, that the dynamo machine of the future will not be of the alternating-current type. The alternating-current appears to be entirely inapplicable to transmission of power, electrolysis, and many other applications of electricity, which must be provided for, in order to insure success in any general system of distribution; it is far more dangerous than a continuous-current, and involves much more loss of energy in the mains. In order to keep the dimensions of the main conductors in a general system of distribution within practicable limits, we have no doubt it will be found necessary to use a current, of at least four or five hundred volts electro-motive force. Such an electro-motive force would be entirely safe with a continuous-current, but with an alternating-current, it would be so dangerous, as to be entirely inadmissible. With an alternating-current also, the loss from induction is a very serious disadvantage. A current of any considerable volume, having its direction reversed thirty thousand times per minute, as in the Ferranti machine, must produce powerful inductive effects in all contiguous objects which form paths for the circulation of induced currents, and the loss of energy from this cause must be quite appreciable, even in short circuits, and in circuits of any considerable length, would be very great.

Such machines, as the Ferranti, may prove useful in installations of moderate size, where the lamps are not far from the machine; but we do not believe that they will displace, to any considerable extent, the continuous-current dynamo machines now in the market, much less that they will work a revolution in the business.

ELECTRICITY AS A HINDRANCE IN MANUFACTURING.

IN many kinds of manufacturing, frictional electricity proves one of the most serious embarrassments, to the satisfactory operation of machinery; especially where the atmosphere is too dry to conduct the electricity to the earth. Textile mills, of all kinds, are especially subject to difficulties of this nature.

In spinning and carding rooms, in dry weather, the fibres repel each other, and stand out in every direction. Every belt, and every spinning band, by their motion, produce enough frictional electricity to represent a large amount of power, although we are not aware that any attempts were ever made, to make careful estimates of the quantity of energy thus lost for application; yet, it is well known that electricity presents numerous difficulties in the several operations of manufacture.

Where the air is heavily charged with moisture, it forms a conductor, which relieves the difficulty. It is this reason, more than any other, which permits England to weave goods with the same machinery as is used in this country, pay the extra expenses of freighting the cotton across the Atlantic, returning the goods, and selling them in this country, after paying duties. The humid atmosphere, supplied by the Gulf Stream, in conducting the electricity generated in her mills, allows England to brave the competition of those other parts of the world, which are more advantageously situated, in regard to proximity to raw material and market. The position of the textile manufacturing towns are not accidents, or hap-hazard coincidences. They are all in places subject to more than the average humidity.

If this country is to compete successfully, in the manufacture of fine fabrics, no crutches, in the form of excessive tariff, will allow us to hobble to prosperity; and traffic is so common between the two countries, that the best machinery is in reach of manufacturers in both countries.

Without neglecting other essentials, it is of paramount importance that the ingenuity of man must accomplish what nature has neglected to do for us; and the solution of this problem, is a matter full of promise to electricians.

Many years ago, the carding room, in the upper story of the Peabody mills, in Newburyport, was known as an "electrified room." So much static electricity was generated and held during dry weather, that it sometimes became impossible to operate the machinery. The difficulty was removed by the use of a large blower, which would force air from the damp basement into this room, whenever the overseer reported that the electricity was causing trouble. It was generally necessary to change the air in the room in the middle of each half day. We have knowledge of many instances, where good results have followed, by placing pointed copper rods around the main belts, and connecting these rods to water pipes, or lightning rods. This would remove only the frictional electricity generated at the main belt, and would have no direct effect upon that from the other belts in the room.

Mills have been set on fire by the frictional electricity from belts.

In the worsted manufacture, it is necessary to store the stock, at a certain stage in the process, in damp basements for a time ranging from one to six months, in order to remove the electricity. A few months ago, it was stated in the English papers, that this operation had been reduced to a few hours, by enclosing the worsted slivers in a copper cylinder, which was closed and the air exhausted, permitting the electricity to reach the copper readily and thence pass to the earth. We are not aware that this process has been adopted in the United States, although it has been commended by an American worsted manufacturer.

The well-known method of blowing small jets of steam in a room, is a poor way of increasing the humidity, because the steam produces a rise in temperature, which increases the capacity of the air to hold water in suspension, and the surplus vapor condenses in minute drops of water, which adhere upon the machinery in colder portions of the room.

The Garland system of moistening a room by means of glass atomizers, has met with success in accomplishing the object for which it was designed.

These atomizers are near the ceiling, and connected with two systems of pipes, one furnishing a supply of water, and the other connected with a reservoir of condensed air. The vapor from these atomizers is in the form of bubbles—not drops—which float in the air, and moisten it very evenly.

There have been other methods of moistening the air: by throwing fine streams of water against some hard surface, as the inside of a sheet metal cylinder, open at both ends, and the draught of air which passes *down* through the cylinder, becomes quite heavily charged with moisture.

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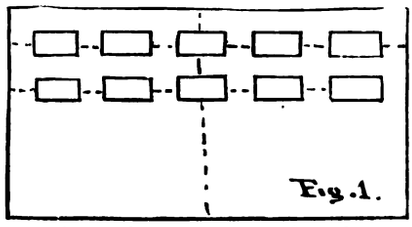

Fig. 1.

In paper mills, the paper coming from the calender rolls is highly electrified, and the surface of the sheets of paper, being a condenser, has a tendency to retain the charge. It is a matter of importance in printing papers, that this electricity be discharged, as it is very hard to manage the paper in the printing press, if it is still electrified. Water in the form of vapor, or spray cannot be used, as it would destroy the finish of the paper; and the method generally used is to stretch copper wires each side of the paper, and their ends fastened to the frame of the machinery, so that the electricity is constantly discharged.

A similar method has been devised for textile mills, by Mr. Francis W. Whiting, of the Boston Manufacturers' United Fire Insurance Company.

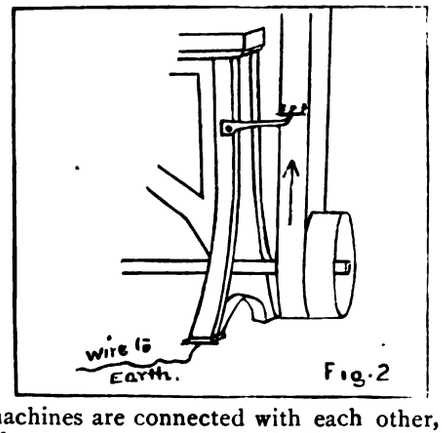

Fig. 2

The machines are connected with each other, as shown in Fig. 2, by means of conductors laid along the floor and leading to the earth. On the outer side of the belts as they *leave* the pulleys, conductors made of brass tubing capped with balls, shown in Fig. 2, draw the electricity to the machines, and thence it is conducted to the earth. In its application, this method is new, and where used, the results have been all that could be desired.

It would be interesting to know how much power in a mill is devoted, under any known atmospheric conditions, to the generation of static electricity; and of greater value, would be any means, by which this electric action could either be prevented or utilized.

In the silk manufacture, it is customary to have channels of water in certain departments; and some processes are carried on in basement rooms, in order to prevent electric action from interfering with the spinning.

The finest muslins in the world are made by a special caste in India, and the work is done at dawn and twilight, when the humidity of the atmosphere is especially favorable for cotton spinning.

In hand spinning, the roving is fed to the spindle between the finger and thumb; and the salient point in spinning by machinery, is the substitution of a front roll, covered with leather, in place of the touch of the live human finger. This leather is cemented upon the roll, and the joint of hard cement injures the fibre, as it passes under it. Now, the substitution of a perfectly homogeneous material for the leather, is a great desideratum. Anything which could be cast around the core, like a printer's roll, would answer in this respect, if it would only meet the greater difficulty of possessing the proper elasticity to pull the cotton, and neither produce electricity nor absorb moisture from the air. There have been one hundred and forty substances patented for this purpose, but none of them have proved satisfactory in practical application. The compounds of rubber become electrified in clear, dry weather, and those materials with gelatine as a base, become covered with moisture in a damp day. A mill, in the central part of Massachusetts, once adopted a compound of gelatine, for the front rolls in one of the spinning rooms, and the result was, at first, eminently satisfactory; until a "dog day" came, and the moisture from the atmosphere settled upon the rolls, and the cotton caught and clogged, so that the cotton could not be spun, and it was necessary to stop the mill, until the abandoned leather rolls could be replaced.

The whole question of frictional electricity in mills, has not received the study which it deserves from electricians; and its successful solution is a matter of sufficient promise, to be regarded as the greatest invention of the century, in the art of textile manufacturing.

STORAGE BATTERIES.

NOTWITHSTANDING the large share of public attention which storage batteries have attracted during the past two years, the practical results so far accomplished with them are entirely insignificant. Our readers will remember the sensation caused by the appearance of the Faure battery. M. Phillipart, the well known operator on the Paris Bourse, who had the matter in charge, managed it with true Gallic appreciation of the importance to business enterprises, of captivating the imagination. After premonitory circulars, warning the public of the impending disclosure of a startling invention, came the famous box of concentrated electricity—a million foot pounds carried in the hand—by means of which Sir William Thompson and the London *Times* were enlisted as gratuitous advertisers. Popular interest in new applications of electricity was already very great, and most men were prepared to accept, without much scrutiny, any plausible statement as to the possibilities or probabilities of new developments.

Here was an invention which seemed destined to produce immediate results of almost incalculable magnitude. Electricity could be stored and transported. Packages of condensed electricity would soon be as common articles of merchandise, as siphons of soda water; and purchasers would have at hand an unlimited store of light, heat, and motive power, readily available and easily managed. All industries would soon be largely modified, and many entirely revolutionized.

Not only have these extravagant anticipations not been realized, but the Faure battery does not appear to have gone into commercial use, even for the purposes for which the most conservative thinkers considered it immediately available.

Companies for working under the Faure patents, appear to have been incorporated in this city, as follows:

The Faure Electric Storage and Light Co	...Capital	$2,000,000
" Light and Force Co	"	5,000,000
" Western States Electric Storage Co.. ...	"	2,000,000
" Southern " " " " ...	"	2,000,000
" New England " " "	"	2,000,000
" Marine Electric Light and " "	"	2,000,000
Total		$15,000,000

We have no means of ascertaining what other companies have been incorporated, outside of New York, for working under the same patents, but we suppose there must be a considerable number.

The energies of the Faure promoters appear to have been expended, for the most part, in the organization of these companies; for, after most diligent inquiry, we are not

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able to ascertain where a single Faure battery is in commercial use for any purpose, in this country, or where such batteries are manufactured or regularly sold.

Soon after the appearance of the Faure battery, it was announced in the newspapers, and apparently upon authority, that Mr. Brush had solved the whole problem of storage of electricity, and had perfected a storage battery of extraordinary efficiency, which the Brush Company would soon be ready to introduce on a large scale, commercially. Although nearly two years have elapsed, the Brush battery does not appear to be anywhere in commercial use. It was not until last December, that the first public exhibition of it was made, and then under such circumstances, that no data could be obtained as to its construction or efficiency. Since then, a similar exhibition has been made at Cleveland, but we are informed that no plants have been sold for commercial use, and that the company is not yet ready to execute orders.

With such large promises and such meagre results, after two years' waiting, it is hardly to be wondered at, that there should be a reaction of opinion, and that many persons should consider the whole matter as delusive and purely speculative. In a recent interview with a reporter of the Boston *Herald*, Mr. Edison has given very emphatic expression to this view of the case. He characterizes the storage battery as entirely worthless for practical use, an absolute failure, commercially, and does not hesitate to call the promoters of the different storage systems, now before the public, some pretty hard names. The arguments which he uses are not new, but they are forcibly put, and will no doubt have their influence with the public. He places the maximum efficiency of a storage battery, in practical use, at 50 per cent., and estimates depreciation at 30 per cent. per annum. The cost of secondary batteries, for a system of distribution, he claims would greatly exceed the cost of laying mains of sufficient size for working directly; and he regards the additional complication involved, in the use of secondary batteries, in such a system, as so objectionable as to render it entirely impracticable.

We have not sufficient data for forming any precise opinion as to the figures Mr. Edison has given, but are inclined to think that he has taken somewhat too low a view of the utility of the storage battery. We have no faith in the availability of the storage system, for purposes of general distribution from central stations. We do not believe that such a system could compete with gas and other systems of illumination, unless the battery used were much more efficient and less expensive than any with which we are now acquainted. Probably, the most serious defect of secondary batteries is in the gradual loss of charge, due to various forms of local action. In a general system of distribution, this would involve a constant and very serious waste of energy, as all the batteries must necessarily be kept sufficiently charged at all times, to develop their normal electro-motive force. Practically, each battery would have to be charged to its full capacity at quite frequent intervals, and in order to provide for emergencies, a capacity would have to be given to the battery, largely in excess of ordinary demands upon it. In the practical operation of such a system, the average amount of energy locked up in the batteries would probably be equivalent to that required for several days' ordinary consumption, and with even a small percentage of waste, due to local action, the absolute loss would be very serious. Such a system may be compared to a system of distributing gas—if we suppose each consumer to be provided with a gasometer, holding sufficient gas for the ordinary use of several days, and a certain percentage of the gas, contained in the gasometer, to escape constantly by leakage.

The best results appear to be obtained when the entire charge, as nearly as may be, is utilized within a comparatively short time after the battery is charged. Although this cannot well be done in a general system, it may be closely approximated in isolated plants for lighting mills, factories, and the like, where the entire apparatus is under the control of a skilled attendant, and the requirements are tolerably uniform and can be determined beforehand. Even in such a case, there would be a considerable loss, and we are inclined to think, that the plant would cost more for running a given number of lights by the storage system, than by the direct system. The depreciation would certainly be much greater. In many cases, however, power costs very little, but is not available in sufficient quantity for running at the same time all the lights required. The plant at St. Denis, of which we give a description in another part of this issue, is a fair illustration of the manner in which secondary batteries may be made available in such cases.

In theatres and other public buildings, where a total extinction of the lights might prove peculiarly disastrous, it may be found desirable to maintain a storage battery in reserve, even at some additional expense, for running the lights a short time, in event of temporary stoppage of the machinery.

It should be borne in mind, moreover, that the introduction of the incandescent light is not, in all cases, purely a question of competition in price with gas. Many users would gladly pay several times the price of gas, if they could have the incandescent light without the expense and annoyance of erecting and maintaining a separate plant. Such users can, in many cases, be supplied from existing lighting stations, by the use of high tension currents, for charging storage batteries, and we have no doubt there will be some use for such a system in spite of its lack of economy.

These and other uses, under exceptional circumstances, where power costs little, or expense is not a controlling consideration, will, we think, create a certain legitimate field for storage batteries, but a far more restricted field than the enthusiastic promoters, of some of the enterprises now before the public, would have us believe. No doubt, many of the difficulties now attending the use of secondary batteries will, in time, be modified or overcome, but the small amount of real commercial progress made during the past two years, with the attention of so many able experimenters, concentrated upon the subject, does not seem to indicate unusually rapid development.

THE ELECTRIC LIGHT AT ST. DENIS.

THE plant recently erected for lighting the works of the *Compagnie des Forges et Chantrers*, at St Denis, France, appears to afford a fair illustration of the advantages which may be secured, under exceptional circumstances, by the use of storage batteries, even although considerable absolute waste of energy is involved in using them. We take the following description of this plant from our contemporaries, *La Nature* and *Engineering*:

The installation comprises 10 Weston arc lamps, run directly from a Weston dynamo machine, and about 30 Maxim incandescent lamps, run from Kabath accumulators, which are charged during the day time by the same machine which runs the arc lamps in the evening. The works lighted are devoted principally to the construction of railway rolling stock, and include large stores of seasoned timber, saw mills, and paint shops, which, more than most other work shops, demand constant watchfulness to avoid fire. For this reason, lighting by gas, or by oil, involves many dangers, while the electric light, properly carried out, is quite safe. The engine at the works does not develop more than about 60 effective horse-power, of which 48 are absorbed by the various machines, tools, etc., leaving only about 12 horse-power available for electric lighting purposes. This the company desired to utilize to the maximum; but running lights directly from the machine, it would not suffice for more than about 10 arc lamps.

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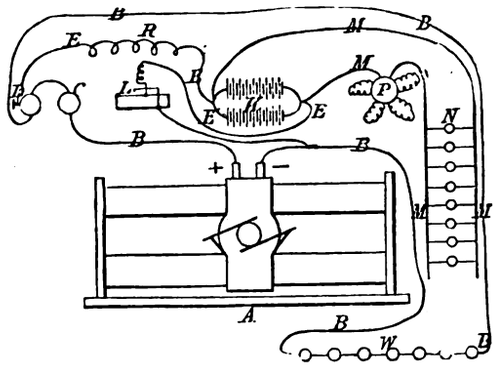
The Weston arc lamps work under the conditions indicated in the recent report of the committee appointed at the Paris Exposition. In the present installation, the generator is driven at 900 revolutions per minute, developing an electro-motive force of 250 volts, and a strength of current of 20 ampères, the electro-motive force being somewhat lower than that recorded in the official report. During four hours each day, the Weston generator is employed in charging 80 accumulators of the Kabath corrugated type, placed about 250 yards from the generator, and connected to it by insulated conductors, arranged overhead. These accumulators, arranged in two series of 40 each, have sufficient capacity to supply, during the period of lighting, each day, (about three hours) the current necessary for feeding 30 Maxim incandescent lamps, distributed over the painting shops and drying sheds. The brushes of the Weston machine can be readily shifted on the commutator, so as to vary the strength of current within certain limits; but for charging the accumulators as arranged, it was found necessary to diminish it still further, and to adopt an arrangement by which the current could be shifted directly from the lamps to the batteries, and back again, without endangering one or the other. For this purpose, an iron wire resistance is introduced into the charging circuit, so that the electro-motive force may be diminished, and in the same circuit is placed an automatic circuit breaker to guard against reversal of polarity of the machine.

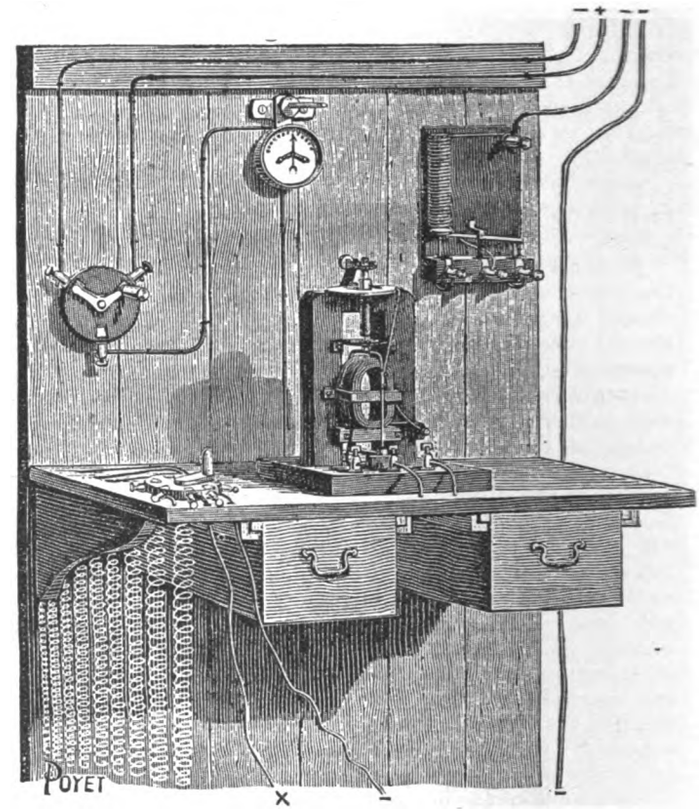
In charging accumulators with a dynamo-electric machine, if the counter electro-motive force of the accumulators should become higher than the electro-motive force developed by the generator, the accumulators would commence discharging through the machine, and reverse the polarity of the field magnets. This would be especially liable to occur, when the machine is started, and a reversal of the charging current would be disastrous to the accumulators. For the purpose of preventing such back-flow of current from the accumulators, an automatic switch is used, which opens the discharging circuit in case of any back-flow of current. Fig. 2 is a diagram, showing the

FIG. 2.



general arrangement of the machine, arc lamps, accumulators, and incandescent lamps. *A* is the dynamo machine; *BB* the circuit for the arc lamps, which are indicated by *W*; *C* is a galvanometer; and *D* a two-way switch, both of which are included in the main circuit. During the day time, the switch *D* is set, so as to connect the generator with the circuit *EE*, which includes the Kabath accumulators *K*, the resistance *R*, and the automatic circuit breaker *L*. At night the switch is set, so as to connect the generator directly with the arc light circuit. The terminals of the two series of accumulators are also connected to the circuit *M*, which includes the Maxim incandescent lamps *N*, arranged in multiple arc; and a fourteen-way commutator *I*, the plates of which are connected to resistance coils of iron wire, so as to permit the resistance of the circuit, to be gradually reduced as the batteries run down, and the strength of the current in the incandescent lamps to be maintained constant by hand regulation. The regulating apparatus and circuit shifting devices are illustrated in Fig. 3.

FIG. 3.



As already stated, the time of charging the accumulators is 4 hours per day, and the strength of current from 20 to 22 ampères. The 10 arc lamps are used for lighting the saw mill, which is 495 feet long, 114 feet 9 inches wide, and 88 feet high. The lamps are placed at a height of 20 feet from the floor. The Maxim incandescent lamps are used for lighting the paint shop, which is 344 feet long, 55 feet 9 inches wide, and 39 feet high. The arrangement used for supporting these lamps is somewhat peculiar, and seems to afford considerable advantages for the purposes for which the light is required. As it is necessary to illuminate the cars in course of construction, and variably, according to the progress of the work upon them, it is necessary to be able to shift the lamps at will, and to place them where the light is especially required. To allow this to be done, the lamps are suspended as shown in Fig. 1. Four parallel pairs of stout uninsulated copper wires are stretched horizontally across the room at a convenient height, and the lamps are mounted upon movable fixtures, which rest upon these conductors. The fixture for each lamp consists of a piece of tubing, enclosing two insulated wires leading to the terminals of the lamp, and terminating at the upper end in two copper arms, which are so arranged as to form contact with the horizontal supporting wires, the whole fixture having the shape of a greatly elongated T. These horizontal wires are connected with the circuit of the accumulators, so that they form conductors leading to the different fixtures supported by them. Good contact between the horizontal wires and the arms of the fixtures, is insured

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by occasionally rubbing the conductors with emery cloth. With this arrangement, the lamps may be shifted at will along the horizontal conductors; and, as these conductors are arranged between the tracks on which the cars stand, the lamps may be placed in any desired position for properly lighting the work in progress.

This plant has not yet been in operation for a sufficient time to furnish exact data as to the cost of lighting, and the advantages it offers, in point of economy, as compared with gas lighting of equal intensity. Certain information on this point, though somewhat hypothetical, is available; but it is clear that the system is greatly superior to lighting by gas as regards security from fire, a matter of very great importance in a factory containing large quantities of inflammable material.

As we have already stated, the power available for lighting purposes does not exceed 12 horse-power, and in this case it costs practically nothing, the additional work of driving the generator adding nothing to the men's wages, and nothing appreciable to the cost of fuel, which consists almost wholly of wood rubbish. A workman who is paid $1.20 per day has charge of the plant; but, as only about half his time is occupied on this work, the item of attendance may be put down at 60 cents per day. The Weston arc lamps use, each, two carbons, .43 of an inch in diameter, one 19 inches long and the other 8 inches, which last during six hours burning. These carbons cost 1.75 francs per meter, and the hourly expense for carbons is, accordingly, about four cents for each lamp, or about $1.20 for the 10 lamps for three hours, including waste. The Maxim lamps cost $1.94 each, and last for about 1,000 hours; equivalent to an expense for renewals, of two cents per hour per lamp, or 18 cents for the 30 lamps; running three hours per day. This part of the lighting will, therefore, cost as follows:

Attendance	.60
Carbons	1.20
Renewals of Maxim lamps	.18
Total	**$1.98**

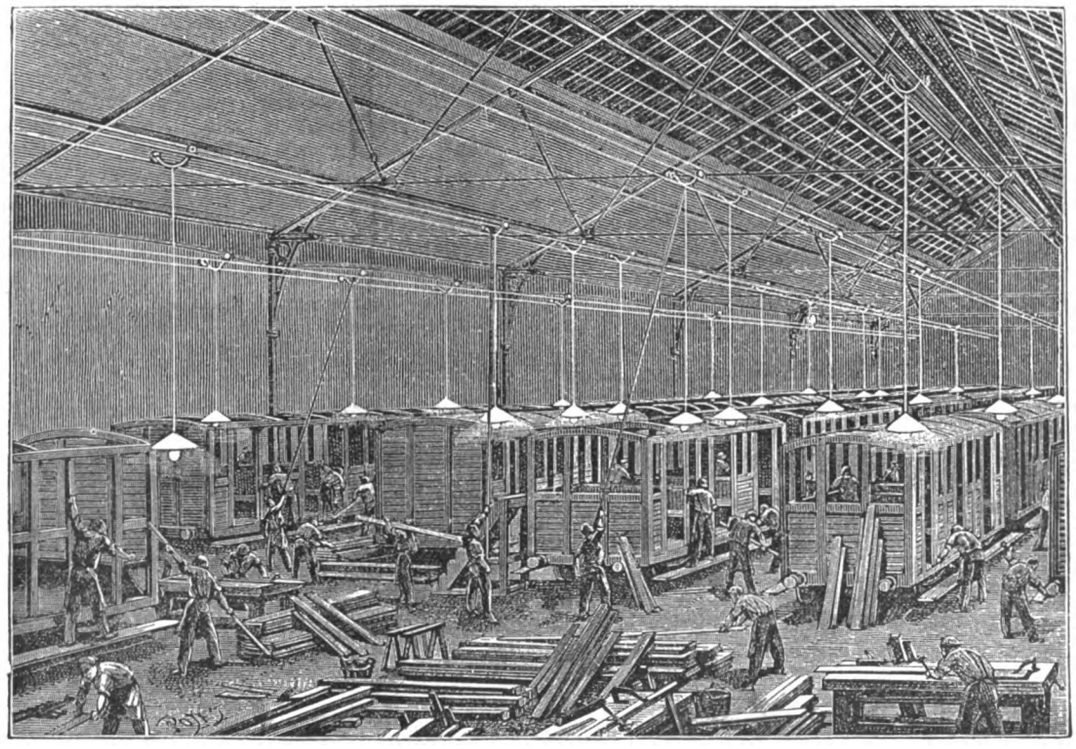
The cost of the acidulated water used in the accumulators, which contains ten per cent. of sulphuric acid, is insignificant. The cost of the installation was $3,600, and taking interest at 5 per cent., and depreciation at 5 per cent., about 56 cents per hour would have to be added for these items, bringing up the total cost to $2.54. It should be borne in mind, however, that no allowance is made in this case for the cost of power, as these figures are based on the assumption that the power costs nothing.

While it is certain that the Weston machine is so well designed and constructed, that its wear is of very small moment, the sum allowed for repairs of the accumulators is, in the absence of absolute data, as low as can be safely assumed. It should be mentioned, however, that Mr. de Kabath undertakes to replace the batteries for nothing as they are worn out, relying upon making a profit on the sulphate of lead produced. Assuming that all the running expenses do not exceed the above figure, a light equal to 1,000 carcels is obtained from the Weston arc lamps, and of 90 carcels from the Maxim incandescent lamps. The cost of gas, to produce the same amount of light, at Paris, would be about $3.54 an hour, or 54 cents per hour more.

In an installation of the kind we have described, and assuming that the power costs nothing, it is not necessary that the duration of lighting should be nearly 1,000 hours per annum, to make the comparison of cost favorable to lighting by electricity. Down to 220 hours per annum there is a saving in using electric light, over Paris gas, and at that point the charges for the two are equal.

The arrangement adopted in this plant can probably be greatly improved in the erection of other plants of the same type. The use of the resistances, either in the charging circuit or for regulating the discharge of the accumulators, is not to be commended; and much better results would be produced, by using a larger number of accumulators and grouping them differently, so as to utilize the entire charging current and by regulating the discharge of the accumulators by varying the number of cells. It is only fair to say,

FIG. 1.



ELECTRIC LIGHT AT THE CAR WORKS OF ST. DENIS.

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however, that Mr. Farquhar, the engineer who had charge of erecting the plant, sought to secure simplicity first of all, and in this we think he has succeeded very well. With additions to the number of incandescent lamps and accumulators, better results will be obtained.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(Continued from page 45.)

THE unison device of the Manhattan intrument is operated by the movements of the clock-work which rotates the type-wheels, and the press-lever, in performing their normal functions. It belongs to that large class of unison devices, in which the action of the type-moving mechanism constantly tends to bring the unison-locking device into operation, while the movement of the press-lever, in printing a letter, constantly tends to the contrary result. In this class, therefore, the unison is brought into effective action, by rotating the type-wheel, while the press-lever remains quiescent.

In the Manhattan instrument, the unison device consists of three different parts. First, the *unison pin*, which is rigidly fixed to the last shaft in the train of clock-work, being the same shaft which carries the escape-wheel and type-wheel. This pin projects at right angles to the longitudinal axis of the shaft, and is in a line with the "unison" or blank space on the periphery of the type-wheel. This pin revolves in the path of a detent, which is placed at the end of a pivoted lever, called the *unison arm*. This arm is attached to a sleeve, which encircles the first shaft of the train of clock-work, and is fitted thereto with a sufficient degree of friction, as to make it move with the shaft as the shaft revolves. The normal movement of the shaft, moving slowly (as it is near the motive power), is to gradually bring the detent on the end of the *unison arm*, in the path of the *unison pin*, and, when the former catches against the latter, the escape-wheel, its shaft, and the type-wheel, are locked and cannot move. Two pins, which are fixed in the frame of the machine, and called, respectively, the upper and lower unison limiting pins, limit the upward and downward excursions of the *unison arm* to the necessary extent. A long lever, running the whole length of the machine, and placed, for convenience, at the back, called the *unison lifter*, has two pins projecting from its ends, one of which is immediately under the free end of the unison arm, while the other pin is under the press-lever. The lever is so pivoted, that a downward movement of the press-lever, and, consequently, of that end of the *unison lifter*, causes an upward motion of the end carrying the pin, which is under the free end of the *unison arm*. The result is, that the *unison arm* is caused to make a partial revolution on its axis, and thus slips around on the shaft which it encircles, as the friction which normally causes it to revolve with this shaft, is not sufficient to prevent it from revolving around the shaft, when the latter is locked, and the arm is struck a sudden blow by the pin in the *unison lifter*. To set all the instruments at unison, therefore, the operator lets the transmitter run without printing for, say, two and one-half revolutions. This gives time for all of the unison arms to have traveled up and hooked on the unison pins, thus detaining all of the type-wheels with the blank space opposite the paper. The operator then depresses the space key, the transmitter stops on that character, the last wave of current sent is prolonged sufficiently to actuate all of the press magnets, the press armatures move downwards, thus unlocking and starting off all of the type-wheels simultaneously, from the same point.

Our next duty is to describe the transmitter for these machines. The transmitter consists of two separate parts electrically, viz: the main and the local parts, but both driven and connected together by the same clock-work and motor power. The key-board, which controls the transmitter, consists of forty finger-keys, one for each character on the type-wheels; each key, when depressed, connecting its own separate wire with a return wire common to all the keys. Forty-one wires lead from the key-board to the transmitter. Forty of these wires are led, one to each of forty insulated metallic segments of a circle, called a *rose*, or *sunflower*, which resembles a similar device used on the Gray private line printers, which were so extensively used before telephones came into use. Each segment of this rose corresponds to one of the keys, and is connected therewith by its own separate wire. Thus the *A* key is connected to the *A* segment (and no other) by the *A* wire, and so on through the alphabet. The return wire from the key-board, which is the wire to which all of the key wires are connected when the keys are depressed, goes to one pole of the controlling local battery. The other pole of this battery is connected to the controlling magnet, and from thence connects to the controlling *follower* or *traveler*. This *traveler* is attached to the last shaft in a train of clock-work, and revolves with it. It has a platinum-armed spring at its extreme end, which rests on the periphery of the circle formed of the alternate metallic and ebonite segments of the rose. If the clock-work be set in motion by a spring or weight, the traveler will simply revolve rapidly around this circle, making connection with each metallic segment, as long as the power is applied. On the same shaft to which the follower is attached, there is rigidly fastened a detent, which revolves in the path of an armature, which is suspended over the poles of the controlling magnet, though normally held away from them by a retracting spiral spring. If one of the keys be depressed, a current will be established through the key, key wire, battery, magnet, follower and segment, as soon as the follower reaches the segment, to which the depressed key is connected. The armature of the controlling magnet is then suddenly attracted, and thrown in the path of the detent, which is on the same shaft as the traveler. The latter remains, therefore, quiet on the segment connected with the depressed key, and stays there until the latter is released by the operator.

The clock-work and weight have for their function the driving of the cylinders, which send out the currents on the main lines. These cylinders are constructed of ebonite, and revolve in baths of oil, which lessens friction and neutralizes the destructive effect of the induction spark. Plates

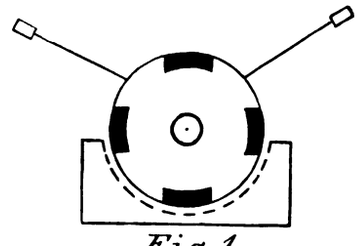

Fig 1

of copper, let into the ebonite cylinders, connect with contact springs, which rest on them in certain positions of the cylinders; while, when the cylinders make one-eighth of a revolution on their axis, the springs rest on the ebonite substance of the cylinders. These cylinders are connected by gearing with the traveler already described, and are started and stopped and fully controlled by the traveler in the manner described. The functions of the springs and cylinders is to allow rapid reversals of current

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to flow to line when the transmitter is running, and a steady flow of current to line when the transmitter is stopped, no matter on what letter. Figure 1, shows a transverse section of one of the cylinders, the four darkened segments representing the copper plates let into the ebonite.

There are two such cylinders required, and they may be of any convenient length and contain any number of sets of segments required for the number of main circuits to be worked.

Figure 2, shows a portion of the two cylinders, sufficient for one main circuit and their connections. They are geared together so that they always occupy the same relative positions, as shown in the diagram. When cylinder *a* has revolved one-eighth of a revolution, so that the springs rest on the plates shown at the lower edge of the cylinder, the cylinder *b* will have advanced so that the springs will rest on the space between two plates. Thus the revolution of the cylinders when connected, as shown in the diagram, causes a constant reversal of polarity, once for every one-eighth revolution of each cylinder, and maintains a constant current on the line when the cylinders are stopped.

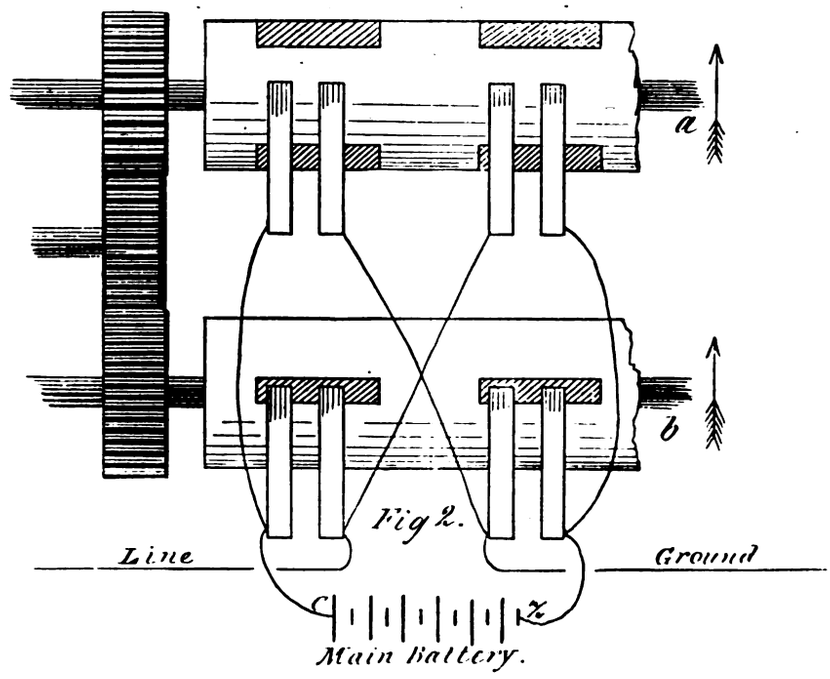

Fig 2.

If the operator has printed a figure, for instance, the *O*, which is required to be repeated immediately, as for instance, in "100," or "1000," it is desirable to repeat that character without making an entire new revolution of the type wheel in order to reach it. This effect is secured in the following manner. In each of the main line wires, just after it leaves the transmitter, are placed the contact points of a relay which closes on the back stroke. The spools of all of these relays are placed in a local circuit consisting of the relays, a local battery and a finger key, called the *repeat key*, on the key board. Normally, all of these relay armatures are withdrawn from their magnets by retracting springs, and the main circuits are thereby kept closed through the platinum back contact points. When the operator wishes to repeat a letter, he holds down the key of the letter printed, and then touches the *repeat key* once. As a result of the latter action, the main circuits are all opened for an instant at the repeat relay points, the press levers all fall away from the type-wheels of the instruments, and are instantly attracted again, thus repeating the last letter printed, without moving the type-wheels.

In order to detain both the instruments and transmitter at the unison point when not in use, a switch on the key-board is turned by the operator, so as to connect the space key with the return wire, without depressing the space key. The follower or traveler on the transmitter then revolves to the space segment, and stops, and remains there with all the instruments at unison, until the next despatch is to be transmitted. Another switch closes the repeating relay local circuit, thus opening all of the main lines, so that the batteries are not connected to the lines when the instruments are idle.

ELECTRIC LIGHT FOR THE BROOKLYN BRIDGE.

THE contract for lighting the Brooklyn Bridge has been awarded to the United States Illuminating Company, which is the local organization of the United States Electric Lighting Company. As the contract is an important one, the competition for it was extremely strong. Bids were put in by all the principal Electric Light Companies, and Mr. Martin, the engineer of the bridge, after a careful examination of all the different systems, reported in favor of the United States Company. Some of the other bidders, however, requested a further hearing, and a committee of the trustees was appointed to make further investigations, and award the contract. At the hearing before the committee, representatives of the Fuller Electrical Company, the Brush-Swan Electric Light Company, the Edison Electric Light Company, the Schuyler Electric Light Company, the United States Illuminating Company, and the Arnoux & Hochhausen Electric Company were present, and the committee gave a full hearing to all, with the result above indicated.

The Weston system will be used, and the plant will comprise seventy arc lights—thirty-five on each side of the roadway of the bridge. The engine and dynamos will be placed in the engine house near the Brooklyn pier, and two distinct circuits will be used, each including alternate lamps on both sides. The work is to be completed, and the lights running within sixty days.

562 FIFTH AVENUE, New York, Feb. 9, 1883.

To the Editor of the Electrician:

GENTLEMEN—Referring to your account, in a late number, of the performance of Kelway's Electric Log (which certainly was remarkable), I would respectfully mention a result given by my Electric Log and Speed Indicator. In September, 1881, I was ordered to test it on board the U. S. S. Tallapoosa, under circumstances suitable for trying its practical qualities. The longest distance run at a stretch, was from Point Judith, near Newport, to Execution Rock. The most carefully measured distance from the charts of the Bureau of Navigation, was 113.6 sea miles; and the indication of my apparatus was 113.5 sea miles.

Very respectfully,

BRADLEY A. FISKE.
Master, U. S. Navy.

—— THE EXTENT to which electrical matters are engaging the attention of inventors at the present time, is indicated by the fact, that about two thousand applications for patents were filed at Washington last year, of which about two-thirds were granted. The electric division is now the largest and most important in the Patent Office.

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SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

IX—ELECTROSCOPES.

BY the progress of Franklin, investigators were stimulated to extraordinary activity, and advanced to the exploration of the new field, discerned from his advanced point of view, by two lines of research, which eventually became broadly distinct, and may now be regarded as qualitative and quantitative methods of investigation.

Qualitative investigations were naturally first most generally pursued, and originated a necessity for instruments, the purpose of which has always been properly limited to evidencing the presence and quality (that is to say, the + or — character) of free electricity, without especial regard to the quantity present. Before proceeding to a consideration of the important discoveries succeeding those so far described, we may, advantageously, advert to the multitude of contrivances which, as this necessity became generally appreciated, gradually appeared to meet it, and which eventually constituted a class of instruments called electroscopes, from two Greek words, signifying to see electricity.

Of these, almost all that have been employed to investigate the phenomena of static electricity have depended upon the law of Mr. C. H. F. DuFay, that like electricity repels; and that, therefore, two or more neighboring bodies, similarly electrified, will indefinitely separate;[2] and the use of the pith balls or birds, in the experiments shown in 32 and 33,[3] to indicate by their persistent repulsion the continued presence of the electric charge, was an anticipation of the earliest recognzied electroscope, Fig. 36, which was proposed by John Canton, of Stroud, in Gloucestershire, in 1753,[4] and was the precursor of the so-called

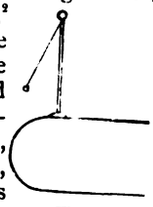

Fig. 36.

DIVERGENCE ELECTROSCOPES,

that form the larger of two classes into which electroscopes, in general, were subsequently divided.

Though resembling the electrical pendulum, Canton's electroscope[5] differs from it radically, in, that the thread used to suspend the ball or balls of pith is made of conducting material such as cotton,[6] instead of an insulating material such as silk, and with the metal supporting stem, forms, practically, an extension of the electrified surface to which, when in use, it is attached. As generally used, it now consists of two pith balls (sometimes gilt) suspended from a wire, the lower end of which is tapered to fit in holes made in convenient parts of electrical apparatus, as the prime conductor, Fig. 37, or in a wooden stand when not in use, as shown in Fig. 38.

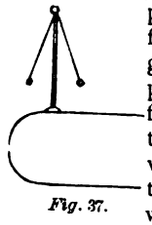

Fig. 37.

Fig. 38.

In order to avoid the repulsive action upon the pith balls, of the vertical metal support, Canton's electroscope, when intended to be used by connecting the electrified object with it by a metal chain or wire, is often constructed as shown in Fig. 39, the pith balls being suspended from a horizontal metal arm, movable through a metal ball supported upon a glass column.[7]

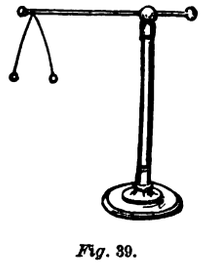

Fig. 39.

1. Webster's Dictionary. Allison's Dictionary of Electricity, N. Y., 1883.
2. Electrician. Vol. I, p. 164.
3. Electrician. Vol. II, p. 14.
4. Canton, John, Phil. Trans., 1753. Vol. XLVIII, No. 93, p. 356.
5. Sir W. Snow Harris' Rudimentary Electricity. London, 1854. P. 32.
6. Lettres sur l'electricite, Abbe Nollet. Paris, 1753, T. I., p. 175.
7. Sir W. S. Harris' loc. cit. Fig. 23, p. 52.

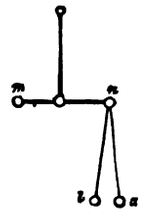

Fig. 40.

Another modification in which even the glass column is suppressed, is shown in Fig. 40, to consist of the usual pair of pith balls, pendant from a similar horizontal wire, which is supported by a glass handle, intended to be held in the hand.[8]

About the year 1783, the practice of steeping the suspending threads in salt water, which originated with Cavendish,[9] greatly increased the efficacy of Canton electroscopes; but the use of threads was soon largely abandoned in favor of more rigid suspending rods, which were first, in an electroscope due to the Earl of Stanhope, delicate reeds, or straws, hanging parallel, as shown in figure 41, and owing to the obviation of contact between them, at the point of suspension, were enabled to respond to an exceedingly slight electrical influence.[10]

Fig. 41.

In order of sensibility and invention, the next of these modifications of Canton's electroscope, Fig. 42, was proposed by Tiberius Cavallo, who suspended the pith balls by wires of fine silver, hanging by loops from a metal ring or hook, whereby great freedom of motion was obtained.[11]

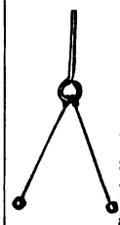

Fig. 42.

Of this famous instrument, Cavallo suggested also a convenient portable form, shown in Fig. 43,[12] the wires depending from a cork, fitting either way in a glass tube, which serves as a handle when the instrument is in use, and as a protecting case for the pith balls when it is laid aside.

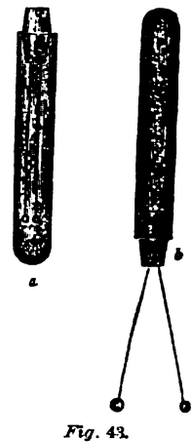

Fig. 43.

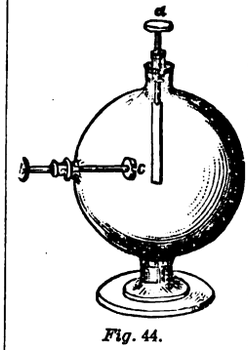

Fig. 44.

Of all electroscopes, however, the most sensitive are those constructed of leaf metal, gold being formerly, aluminum now, generally preferred. A strip of gold leaf, gummed upon a stick of sealing wax, when brought near a body slightly electrified, is strongly affected.[13] Such a leaf, Fig. 44, suspended in a glass case to protect it from movements of the atmosphere, and, if necessary, containing also a piece of calcic chloride to keep the air dry, is an exceedingly delicate form of electroscope, due to Dr. Hare of Philadelphia.[14] But the double gold leaf electroscope, the most delicate of all divergence electroscopes, and the first in which metal leaf was used, invented by Bennett in 1787,[15] is shown in Fig. 45, and now consists of a pair of delicate aluminum leaves, slightly separated at the top by a strip of gilt cork, and hanging side by side in a protecting glass vessel. When they widely diverge, they can touch strips of tin foil, gummed upon opposite interior sides of the case, or columns, suitably located, and communicating with the ground.

Assuming electricity to be a variety of *force*, and applying to it, for convenience, the terms according with the

8 Ibid., fig. 7, p. 13.

9 Benj. Franklin's letter to Nairne, Oct. 18, 1783. Works by Jared Sparks. Boston, 1856. Letters, vol. V., p. 479.

10. Rudimentary Elec., Sir W. S. Harris. London, 1854. Fig. 24, p. 52.
11. Ibid., p. 52.
12. Hunt, Elem. of Phys. London. Fig. 138, p. 207.
13. Rudimentary Elec., Sir W. S. Harris. London, 1854. P. 13.
14. Ibid., p. 50.
15. Bennett, Phil. Trans., 1787. P. 26.

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assumption, the extreme sensibility of this instrument may be thus explained.

The repulsion between the gold leaves, depends on the quantity of electricity with which they are charged. This quantity, in turn, depends upon the difference of potential between the leaves and the conductors in their neighborhood; for, if the columns or strips of tin foil are omitted, and the entire instrument insulated, but little electricity will reach the gold leaves, even from a highly charged body, and they will be, with difficulty, affected. The ordinary electroscopes are enclosed in glass, the surface of which is varied in potential, by conditions over which we have no control. Faraday has shown that the case should be metal, or the glass covered with a cage of wire gauze, the meshes of which are close enough to keep the whole surface of the glass at one potential. Then, if the columns be connected with the earth, whenever there is a difference of potential between the cap of the instrument and the earth, the leaves will freely show it.[16]

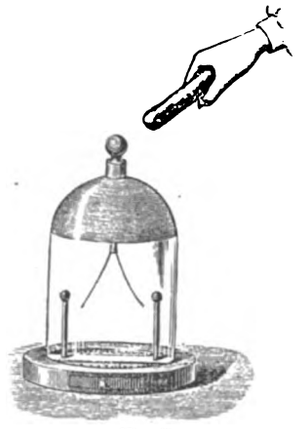

Fig. 45.

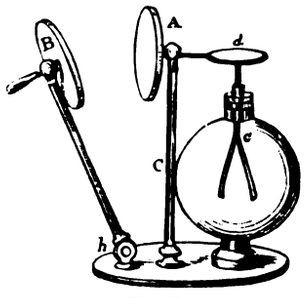

Fig. 46.

Sensitive as it is, the delicacy of Bennett's gold leaf electroscope may be increased by the combination with it of the condenser, Fig. 46, a device which augments the effect of an electrical influence communicated to it.[17]

Neither of the above instruments tells, at once, which kind of electricity is communicated to it.

Bohnenberger's electroscope, Fig. 47, which dates from the year 1820, and indicates not only a most inconceivably minute trace of free electricity, but at the same time, whether it be + or — is, therefore, by many esteemed the best. It consists of a small Zamboni pile, of about 500 pairs, supported horizontally beneath a glass shade, and connected through the bent wires *a*, *b*, adapted to its ends with two gilded parallel plates *p*, *m*, which form its poles. One of these is, therefore, always charged with + the other with — electricity, and between them hangs a strip of gold leaf *d*, *g*, which communicates with the plate *o*, *n*, through the rod *c*. Normally, the leaf is equally attracted by both poles, and hangs quiescent, but the presence and nature of the slightest trace of electricity communicated to it, is shown by its motion toward the plate which has the opposite polarity.[18]

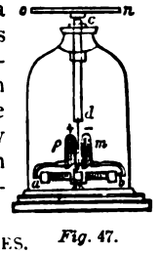

Fig. 47.

BALANCED NEEDLE ELECTROSCOPES.

Under this general title, electroscopes of the second class are included; and the earliest and simplest representative is that shown in Fig. 48, which consists, essentially, of an insulated needle, free to revolve. The needle being at rest, an electrified object brought near one of its gilded terminal discs repels it, but even though suspended by a fibre of raw silk, the necessary torsion of the fibre limits its delicacy.

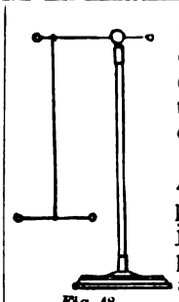

Fig. 48.

More sensitive is the modification, Fig. 49, which is constructed of a bent wire, supported on a pivot, and extended by two adjustable straws, in the ends of which, short pieces of wire, terminating in gilded discs, are inserted.[19]

Tyndall's lath balanced on an egg, is a variety of this device which suppresses the metal point.[20]

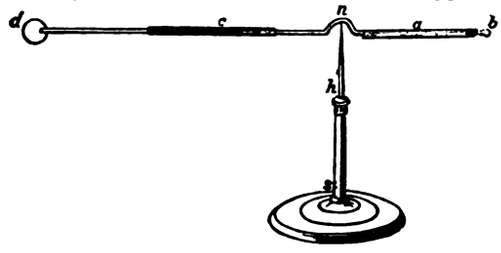

Fig. 49.

Next in order of sensibility, is the modification, Fig. 50,[21] constructed of straws, needles, and balls of pith.[21]

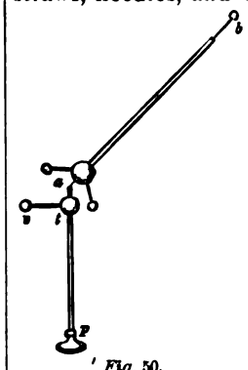

Fig. 50.

Fig. 51 presents, finally, Peltier's electroscope, the most delicate of this class,[22] which consists of a carefully poised aluminum needle, normally maintained by a magnet in the magnetic meridian, and a frame surrounding and in electrical connection with it, so placed, that when the needle is at rest, it is nearly in contact with its gilded terminal discs. From the same principles which explain the delicacy of Bennett's electroscope, it derives so great a sensibility that the least electricity applied to the frame (*c*, *d*,) will repel the needle.

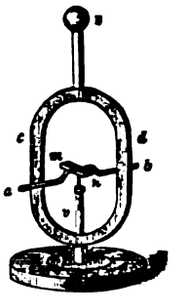

Fig. 51.

Experience indicates that electroscopes should be enclosed in cases, which may be kept dry, internally, by calcic chloride, or hydric sulphate; and may, when necessary, be dried externally by a hoop of wire, wound with cotton wool, saturated with alcohol, which, when ignited, forms a circle of flame, to be passed once or twice over the case. But a coating of atmospheric moisture, on the outside, is some times desirable. Needles and suspending wires may be advantageously made of aluminum, and torsion threads of spun glass.

— IN ONE OF THE course of lectures upon "The Sun and Stars," which Prof. S. P. Langley is delivering at the Lowell Institute in Boston, the speaker said that the light of the sun is two and a half times as brilliant as the same area of electric (arc) light; and that if a calcium light be held between the eye and the sun, the light would appear to be a black spot upon the sun. As a measure of comparison, in assisting the comprehension of the infinite quantity of light thrown off by the sun, he remarked, that if there was an electric light of 2000 candle power on each square foot of the surface of the earth, then the whole light from the earth would be less than one-billionth that from the sun. The intensity of the sun-light is one hundred and thirty thousand times that of a standard candle.

16. Fleming Jenkins, Elec. and Mag. N. Y. 1873.
17. Bennett, Loc. Cit. Sir W. S. Harris, Rudimentary Elec. London, 1854. Fig. 26, p.58.
18. Draper, J. W. Nat. Phil. N. Y. 1847. P. 297. Noad, H. M. Text Book of Elec. London, 1867. P. 73.
19. Sir W. Snow Harris. Rudimentary Elec. London, 1854. Fig. 22, p. 49.
20. John Tyndall. Lessons in Electricity.
21. Sir W. S. Harris. Ibid. Fig. 25, p. 53.
22. Fleming Jenkins. Elec. and Mag. N. Y., 1873. P. 38.

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PARIS CORRESPONDENCE.

WE have good reason to believe that the present year will expire, without our having to announce the realization of important progress in the industrial application of electricity. After disappointment in so many expectations, it is natural that the public should become exceedingly conservative, if not skeptical, regarding electrical projects, and we shall, therefore, reserve the description of projected experiments, until we can announce that the results have been attained.

The name of Marcel Deprez is, to-day, so well-known to electricians, that any eulogy of him would be superfluous.

To his initiative were due the experiments in the electric transmission of power, recently conducted at Munich, by which it was demonstrated that power could thus be transmitted by means of an ordinary galvanized iron telegraph wire, from four to five millimetres in diameter, to a distance of 50 kilometres. The result, it is true, was low, for at Munich the power received was only about one-quarter of the initial power applied; but if it left something to be desired, from a practical point of view, the experiment was, from a scientific point of view, most remarkable. Since then, Mr. Marcel Deprez has persevered in his studies, at Paris, and, if we are correctly informed, experiments are to be made soon on the Chemin de fer du Nord. It will be very interesting to observe whether this electrician has obtained a truly practical solution of the problem. Generally he fails to appreciate the requirements of industrial use, and forgets that a workshop is not a laboratory.

The experiments at Munich have demonstrated, that with the excessively high electro-motive force he requires, special precautions must be observed, to insure the operation of the machine. This detail, having been at first overlooked, presented itself as a practical difficulty which necessitated stopping the machine very soon after it was started, and the numerous repetitions of this accident lead us to believe that the practical solution of the problem has not been attained. We shall soon know whether Mr. Marcel Deprez has been more fortunate in the construction of his new machine, and as the trial is to be made in Paris, he will have at hand all the resources necessary to assure success.

In exceptional cases only, will it be necessary to transmit power to a distance of more than a few kilometres. It is, therefore, natural to avoid augmenting the difficulty by attempting to do too much at once. Some practically successful examples of the transmission of power to a distance of five or six kilometres are on record, as having been obtained in a coal mine, in the Valley of the Loire. According to the statement of results, the power recovered represented more than 50 per cent. of the effective power applied; that is, after making proper deductions for loss in the engine and in transmitting to the primary generator. In this case, the power necessarily transmitted was not merely a few kilogrammetres, but several horse-power, for the receiving electric motor drove a winch, which served to raise the buckets of coal out of the mine.

So far, we have had no occasion to mention experiments in the application of electric motors to producing still greater power, such, for example, 20 or 30-horse power, or, in other words, to the needs of general industry. Upon the day when such a power can be thus distributed, within a radius of five or six kilometres, the electric transmission of power will cease to be considered as a dream, and will become the auxiliary of a host of enterprises. In a few weeks, experiments will have justified these previsions; and we shall not fail to keep our readers informed in regard to them.

Since the progress accomplished in the construction of dynamo-electric machines, has awakened us to the advantage of electric lighting, it has been attempted, but unsuccessfully, to introduce it in the interior of private houses. The gas engine, unfortunately, is not available for driving a dynamo-electric machine, because of its rhythmic acceleration and retardation, which are translated into disagreeable periodical variations in the luminous intensity of the electric lights; it is useless to think of employing steam engines for running a household system of lighting, or the special distribution of power in buildings, occupied by small industries; the distribution of the current to residences, by the Edison system, is practicable in particular cases only, and is even then still doubtful; while finally, the accumulators or storage batteries, though extremely adaptable in principle, require the periodical intervention of a dynamo-electric machine, or else expensive renewals.

All of these considerations have led to the development of increased interest in the study of galvanic batteries, and to the conducting of investigations for determining whether it may not be possible to produce a current suitable at least for incandescent lamps, by means of new combinations which will avoid the great inconveniences incident to batteries of the present form.

It is useless to think of the Bunsen battery, for its disagreeable and even dangerous emanations absolutely prohibit its use; the ordinary bi-chromate of potash battery becomes rapidly polarized, and at the end of a very few minutes diminishes in power; as for other known forms of batteries, they are not adaptable for such service unless applied in impracticably large numbers.

The problem assumes therefore, the following form: to find a battery, giving rise to no poisonous or disagreeable emanations, requiring no complicated manipulations, preserving its entire energy during many hours, and capable of giving a current powerful enough to run incandescent lamps.

We should not be surprised if the public was soon called upon to consider the announcement of some new discoveries in this direction. It is needless to premise that such a battery would serve for the production of motive force, as well as a lighting current, and that it would also answer for various other requirements. Its appearance would be the leading event of the year, and would be accompanied by the use of electricity in almost all apartments, large and small.

During the last few years in Paris, a great deal of attention has been given to the establishment of a metropolitan railway, and since the Paris Electrical Exhibition in 1881, a distinguished engineer, Mr. Cretien, has advanced a project for an electrical railway, to unite the principal districts of the capital. A special commission of the Municipal Council of Paris has examined the matter, and without reference to the system of branches to be established, it discussed three projects as follows: 1st, that of Mr. Cretien, for electric traction; 2nd, that of Mr. Ollivier, for funicular traction; 3d, that of Mr. Tullien, for electric and funicular traction.

Electric traction, as is well known, is obtained by means of an electric-motor, to which the current, produced by a dynamo machine in a central station, is conducted. It is, in fact, an application of the electric transmission of power in a special case, the importance of which is hardly conceivable. The adoption in principle of this method of traction, shows the confidence that is placed by the engineer in electricity, and we shall see, before a great while, that this confidence is justified.

PARIS, Feb. 8th, 1882. PH. DELAHAYE.

—— A MAN WITH a slight ailment communicated with his physician through the telephone. This doctor, after asking enough questions to tire out a well man, said: "Let me see your tongue! I think I understand your case, but never prescribe without seeing my patient's tongue."

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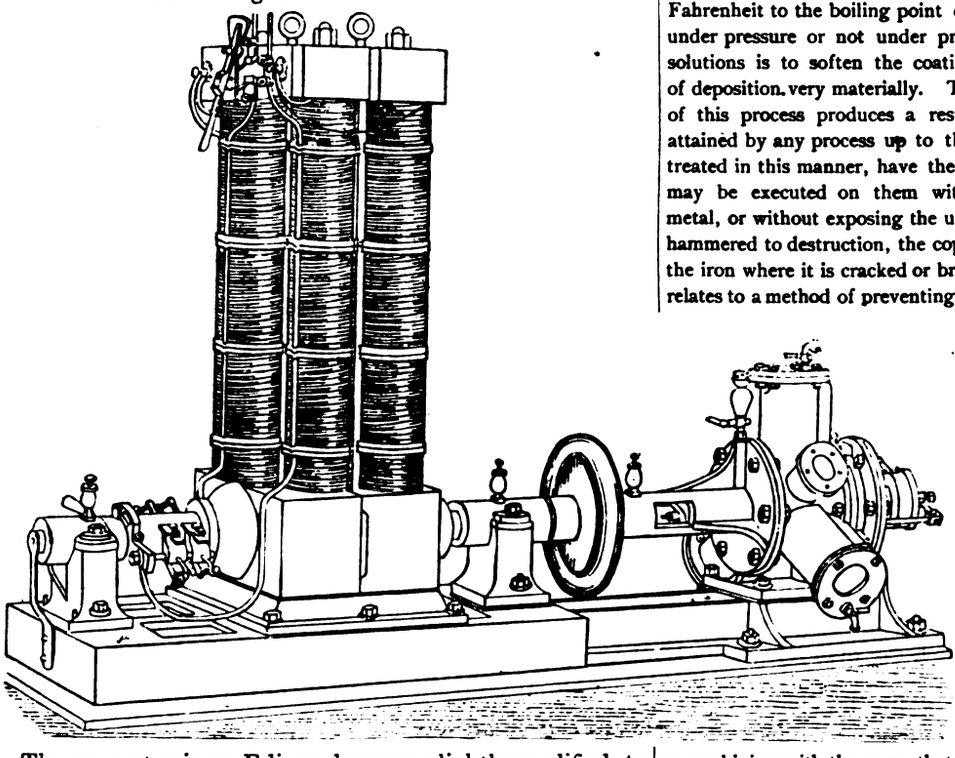
THE ELECTRIC LIGHT ON BOARD VESSELS.

THE English "Edison Electric Light Company" has recently made arrangements for lighting the two vessels: the Tarawera, and the Waihora, belonging to the New Zealand Union Steamship Company. The first vessel was built by Messrs. Denny, in their yards at Dumbarton.

The dynamo-electric machine, and the Brotherhood motor, which works it, were placed in a small room some 11 ft. x 10 ft. 10 in. x 6 ft. 3 in., adjoining the engine room. The conductors were very carefully laid, perfectly insulated wires were used, and they were protected by gutta percha and an impermeable coating of paraffined thread. Extra precautions were taken to have the current interrupted in case of over-heating. The lamps are the Edison model, of 16 candles, requiring an electro-motive power of 96 volts to produce their normal light.



The generator is an Edison dynamo, slightly modified to diminish the velocity, so that it can be worked directly by the steam motor. The following are the principal details: Resistance of armature, 0.1 ohm; resistance of each element of the magnetic field, 20 ohms; speed, 475 revolutions per minute; electro-motive power, 96 volts; current, 120 ampères; length of armature, 63 inches; diameter of armature, 125 millimetres; number of lamps supplied, 150, of 16 candles each; resistance of the heated lamps, 125 ohms.

The three cylinder motor which is used, has cylinders of 175 millimetres in diameter, with a run of 112 millimetres, and develops a maximum power of 20 horses. Both the motor and the electrical machine are mounted on the same foundation slab, which is firmly screwed down on a teak flooring, 75 millimetres in thickness. The annexed drawing gives a general view of the arrangement adopted.

The experiments were perfectly satisfactory. The machine worked with the greatest regularity, and without any periodical variations of intensity, that are sometimes so difficult to avoid. Electric lighting is one of the improvements that passengers most appreciate during a long voyage, and its general introduction on vessels, is now imperative.—*L'Electricien.*

IMPROVEMENTS IN ELECTRO-DEPOSITION OF BRASS AND BRONZE

WE learn, from a foreign cotemporary, that some improvements in the electro-deposition of brass, bronze, and other metals, have been recently patented by W. H. Walenn, of England. The absolute adhesion of the coating to the metal, together with constancy of the solution and softness and ductility of the deposited metal, are the results of the methods used. The first part of the invention relates to electro-depositing copper upon iron and similar metals, so that the coating may be adherent and in a soft condition. Preferably, the solution used is compounded of thirty-two ounces avoirdupois of cyanide of potassium (70 per cent. real cyanide) and one ounce of neutral tartrate of ammonium per gallon of liquid, and it is charged with copper by electrolytic means; the solution is then made complete by the addition of cupric ammonide. The solution is used at a boiling heat, or near thereto, namely, from 150° Fahrenheit to the boiling point of the solution, whether the solution be under pressure or not under pressure. The effect of heat upon these solutions is to soften the coating of copper, and to increase the rate of deposition very materially. The following example of the application of this process produces a result, which, it is stated, has never been attained by any process up to the present time. Thin sheet iron plates, treated in this manner, have the coating so adherent, that repoussé work may be executed on them without interfering with the continuity of metal, or without exposing the underneath or coated metal. If a plate be hammered to destruction, the copper coating will be simply extended over the iron where it is cracked or broken. The second part of the invention relates to a method of preventing the too great evaporation of a solution which is heated during deposition. The conducting wires, from the source of electricity, are passed through the depositing tank, but are insulated therefrom, and all rods or wires for suspending anodes or cathodes, have their bearings upon inside shelves, mounted with slabs of non-conducting material. Over the whole, and dipping into a water seal, is a counterbalanced cover, that is removable by means of pulleys and slinging chains. To an aperture in the cover, is adjusted a long condensing worm tube, opening into an upper vessel or box, that contains materials which are capable of condensing, or absorbing or combining with the gases that escape. The liquids flow back down the tube into the tank. This improvement applies to cyanide coppering, brassing and bronzing solutions, to gilding solutions, and to all electro-depositing solutions that are heated. The third part of the invention relates to working copper, brass, bronze, gold, and other electro-depositing solutions, in a closed vessel under a known pressure, the pressure being applied by heating the solution or otherwise. This plan has the great advantage of preserving the purity and stability of the solution, and of preventing its waste by evaporation; it enables the electro-deposit to be uniform over the surface of the cathode, and to be of compact and uniform quality throughout. A high pressure is not recommended; a single atmosphere is in general, more than sufficient. The closed vessel may be used for solutions in which there is free ammonia, or where it is essential to keep the solution free from dust, or where other conditions arise in which it is necessary to inclose the solution, although neither appreciable increase of pressure arises, nor is heat applied. If there be much gas or vapor coming off, the condensing worm tube opening into a vessel may be employed. Another improvement consists in adding to the charged and finished solution in the cold cupric ammonide, until the solution is slightly green in color. In a solution treated in this manner, it is exceedingly difficult to isolate the combination containing ammonia, so as to obtain its formula; but, from the constancy, persistency, and stability of a solution treated with cupric ammonide, as above described, it seems most probable that a definite ammoniacal salt is formed, which is not decomposable (or is difficult of decomposition) at a high temperature.

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THE LARGEST ELECTRO-MAGNET.

THE largest electro-magnet in the world, according to the German *Humboldt*, is that in the physical institute of the Greifswald University. It is made of 28 plates of iron, each 7 millimetres (about ¼ in.) thick. A massive iron core was not permissible, owing to the cost and other difficulties. These plates were so cut that their width corresponded to the consecutive parallel chords of a circle seven times 28 mm. (20 in.) in diameter. They were heated in a fire, and bent to a horseshoe form The sides that were to be opposite each other, were varnished or lacquered, to make the action of the extra current as great as possible, and then they were fastened together. The projecting edges were then filed off smooth. In this way a horseshoe magnet was obtained that is 1,270 mm. (51 in.) high. The diameter of the cylindrical core is about 8 in., and its total length 9 ft. The distance of the poles from the centre of the cylinder is 24 in., and the weight of the core 1,381½ lb. The magnetizing coil is partially of copper ribbon, and partially of copper wire. The strips of copper are in rings of 15 windings each, separated from each other by strips of gutta percha, and soldered together to form a continuous-current. The copper wire is put around it up and down, two and two, with thick paper between the layers. There are five double layers of two wires each, so that with the copper ribbon there are 25 courses, one over the other, the weight of them being 605 lb. Total weight of core and coil, 1,986½ lb.

For comparison we give the size of other large horseshoe electro-magnets:

	Faraday's.	Pluecker's.	Greifswald.
Length of core	46½ in.	53 in.	108 in.
Diameter of core.	40 in.	40½ in.	80 in
Weight of core	142½ lb.	185 lb.	1,381 lb.
Distance of poles	6.0 in.	11.4 in.	24.0 in.
Number of layers of wire..	3	3	25
Total weight.	187 lb.	262 lb.	1,986 lb.

The iron core is cemented in a box made of stout oaken plank, and resting on wheels. The current is generated by 54 Grove-Poggendorff cells. With this powerful instrument a great variety of experiments can be performed. When a copper cylinder, containing 40 grams of Wood's fusible metal (melting at 65° or 70° C.), is rotated between the poles, it melts in less than two minutes. A rotating copper disc, 10 in. in diameter, which can be rotated rapidly in a vertical plane by means of a weight, is almost stopped on closing the current. The rotation of the plane of polarization in Faraday's flint glass is seen when the light passes through it only once. By using a sugar solution in a tube 8 in. long, the plane of polarization changes from red to light blue on reversing the poles. The magnetic action on liquids, gases, and flames can be made visible to a large audience.

—— SOME ELECTRIC APPARATUS connected with the watchmens' clock in a mill did not operate satisfactory at times, and an examination showed that there was an "escape" of electricity, while the machinery of the mill was in operation, but there was no such indication at tests made at night or during the noon hour. It was finally decided by the electrician in charge of the matter, that the sparks of static electricity from the belts formed conductors from the wires to the ground, and it is stated that the difficulty was removed by changing the position of wires from proximity to belts. While we are not in a position to deny that a succession of sparks could be the source of the difficulty, it is more probable that the motion of the machinery, moved some conductor against the electric wires. We recall a similar instance, where one of the wires of an electric light circuit in a mill, was swayed against a water-pipe, by the jar of the mill when the machinery was in motion, but it hung away from the pipe when the machinery was not in operation. As in the first instance, tests made outside of working hours, showed that the line was clear, and then when the dynamo was in use, a test by a ground wire, showed the presence of some other ground connection; and, as a natural consequence, those in charge of the lights were disposed to doubt the adequacy of the magnets used to test the insulation of the system.

SPARKS.

—— THE PARC MONTCEAU, placed in one of the most fashionable parts of Paris, is now lighted by Jablochkoff candles with success.

—— THE PRINCIPAL STREETS OF GRAND RAPIDS, MICH., and a large number of stores, hotels and business houses in that city, are beautifully illuminated by 170 of the standard lights of The Fuller Electrical Company.

—— A STRONG BREATH.—On a clear, frosty evening, some young men were chatting in Madison Square, when one noticed that the electric light showed the shadow of the vapor in the breath, very clearly upon the pavement, and called those present to witness, that his companion's breath was strong enough to cast a shadow.

—— THE WHEELING ELECTRICAL COMPANY, organized some months ago, has recently placed itself in position for continuing the operation of The Fuller Electrical Company's system, which it has had in use for six or eight months past, and for materially extending the same in the city of Wheeling and its vicinity.

—— ON A COAL WHARF, in Lynn, a St. Bernard dog, in the office, barks when the telephone call rings, if no one is in the office, but when any one is present, he does not appear to notice it. So, when the main office, in the business quarter of the city, wish to communicate with the wharf, if they hear a good natured bark, it is known that no one is in the office on the wharf.

—— MR. GEO. F. MILLIKEN, for many years manager of the Western Union Tel. Co. at Boston, Mass., has lately established an agency for the sale and installation of the apparatus of The Fuller Electrical Company, having his headquarters at 37 Pearl Street, Boston.

—— IN EXPLANATION of the statements made upon the increased economy of steam navigation, in the editorial of our February issue (page 42), we would state that the Persia (1856) consumed 14,500 pounds of coal, during the passage across the Atlantic, for every ton of cargo The Arizona (1882) has made the passage with a consumption of 450 pounds of coal to the ton of cargo.

—— MESSRS. MAWSON AND SWAN, of London, have introduced a small accumulator, which is said to be capable of supplying one lamp continuously for two hours. The power of the lamp is not mentioned, but it has been used for taking photographs. The accumulator weighs five pounds. The modified Planté secondary batteries, used at the Savoy Theatre, weigh less than four pounds,

—— ELECTRICITY FURNISHES a new way of obtaining money at fairs. Place a coin in a basin of water, connected to one wire of a coil, and for a dime or so, allow persons to try and pick out the coin, on condition that they hold the other electrode. It is advisable that the resistance of the water be decreased by dissolving salt in it. If the battery and coil are properly arranged, no mortal can grasp a coin under four inches of water.

—— A GENTLEMAN, when in an office at the corner of Oliver and High Streets, Boston, was much startled because a thread of fire reached from his ear to a gas fixture. He had previously been in a manufactory, and wearing rubber overshoes, became charged with electricity from belts, and his gloves prevented a discharge when touching doors, etc., until the aforesaid ear came in proximity to the gas fixture. Several persons witnessed this phenomenon.

—— THE LONDON *Times*, says: In following the development of electric engineering, all the world is learning new terms and new language. Words which three years ago either did not exist or were understood only by men of science, are to-day in the common language of engineers and their workmen—to-morrow will be used by the general public. "Electro-motive force" and "current," "volts" and ampères," are becoming terms as well known, as "pressure of water" or "cubic feet of gas," and it is necessary that this should be so, as the time is fast approaching when the public will find their quarterly bills for the supply of electricity made out in "volts" and "ampères," and will have a right to sue their local electric company if their daily supply of "current" is insufficient, or is given at a wrong "electro-motive force."

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—— *Nature* says, a new electrical paper, *Electricity*, has issued its first number at Buda-Pesth. It is written in the Magyar language. The first paper of this description ever published was called *Les Archives de l' Electricité*, and was published by M. de la Rive, at Geneva, in 1840; and the first issued in England was edited by the late Mr. Walker, in 1843, under the title, *Electrical Magazine*. None of these papers lasted for more than three or four years.

—— THE ADVANTAGE OF lighting vessels by electricity was clearly demonstrated recently. The steamer Carolina, of the old Bay Line, between Baltimore and Norfolk, ran into the British steamship Riverdale, in a dense fog off Cedar Point, on Chesapeake Bay. The electric lights of the Carolina were extinguished only in the damaged part of the boat, and her officers think that if she had been lighted in any other way, a conflagration would have followed the collision.

—— A YOUNG MOTHER, hearing her infant cough, in the night, summoned the family physician by telephone. The doctor did not wish to come out in the storm, unless it was absolutely essential, so he asked many questions, relative to the character of the difficulty, but the answers were unsatisfactory, until the infant was held before the transmitter, and, by its cough, satisfied the physician that it was merely a cold, and not the dreaded croup, and therefore advised them what course to take.

—— A CONDUCTING WIRE of a Brush day circuit, was cut by the employee of a rival company in Boston, the other day, and his unappreciatiye employers informed him that they carried on a competition on a different basis, and gave him permission to find employment with some other company. Nevertheless, the man will never do so again. The blinding flash of an arc, about two feet in length, scared him and made the nippers blue ; and, although standing on a floor, he received a severe shock, probably from the pulsations of the current.

—— THE NEW CAPITOL COMMISSIONERS, in their annual report to the Legislature, state that the results of the Maxim and Weston installation at the Capitol has been most satisfactory. That the advantages derived from the use of the electric light, are not only in the fact that the light is steadier, clearer, more healthful, and in every way more desirable than gas, but it is more economical. The commissioners recommend, in view of the economy in cost, and the healthful and perfect character of the light, that it be introduced into the legislative departments and suites of rooms.

—— THE VENTILATION of the State House, in Boston, has been poor, and the difficulties in the way have not been fully mastered, by the expensive and thorough changes, made at various times. With the increase of business, in this building, the matter of ventilation has been a serious question, A partial solution is to be attempted, by preserving some of the air from vitiation, by substituting electric lights for gas. Speaker Marden has appeared before the Committee on Public Health, relative to the matter, and it is said that the legislation necessary to make the change in light, will be carried into effect.

—— AT THE ANNUAL FAIR of a Grand Army Post, a very neat electrical railway, made by a youth of eighteen years, attracted much attention. The railway was five inch gauge, and ran around the hall, about ten feet above the floor. The two rails formed the conductors of a bi-chromate battery of four cells, while a small motor was contained in the locomotive. This apparatus did good service in advancing the objects of the fair, by giving patrons an opportunity to place a dime in any compartment of the four cars, forming the train, when the train would speed to the other terminus, and each ten cents replaced with a sealed package, on the "grab box" principle. The current was reversed in the rails, and the train returned. The train was stopped in a very ingenious manner, by leaving an opening in the rails, about ten feet from the terminus, where it also met with an up grade. The withdrawal of the motive power, and the slight ascent, were enough to bring the train to an easy stop, when it was caught by a latch ; when the latch was opened, the train would move along the incline, by virtue of its own weight, to the place where it would reach the portion of the railway which formed the conductors.

—— THE PRINCIPLE of the well-known apparatus, using the bending of a compound bar of iron and brass, to close a circuit and sound an alarm, when the temperature of a room exceeds a fixed limit, has been put to a novel use, as an alarm for hot journals, in a large shop in Hartford, Conn. In the journals of all the shafting, except the countershafts, are small bars, made by soldering a brass wire against a thin strip of steel. When any bearing becomes warm, the bar bends, as the brass wire expands in the proportion of five parts, to every three parts that the steel expands. The bar is secured at one end, and, when bending, opens a circuit, and gives an alarm in the engine room. There are several circuits, so that the vicinity of the difficulty is known at once. The bars are so regulated, that an alarm is given long before a journal becomes seriously warm ; and since its use there has been no difficulty, caused by hot bearings.

AT A RECENT ADDRESS after the dinner given to General Sherman on his sixty-third birthday, he eloquently said: When we who are seated at this table to-night, look back over the past half century and compare it with any other equal period of which history treats, we must confess that our lot has been a happy one. Steam and electricity have brought all parts of the human family into closer and more friendly relations, and give just reason for hope, that before another century passes, Burns' prophecy will be fulfilled—

"When man to man the world o'er
Shall brothers be for a' that."

The photograph, the telephone, the McCormick reaper and hundreds of labor saving machines have, in our day, vastly added to the world's wealth, and the ability of every man to enjoy his fair share of the fruits of the earth, and the embellishments of life.

—— THE *Lowell Daily Courier* says : The circuits of the Electric Light Company (Arnoux and Hochhausen). at Lawrence, Mass., are arranged with much judgment. Starting from the lighting station on the south side of the Merrimac River they cross over to the city, and are placed on poles along an alleyway between the two parallel business streets. As the wires enter at the rear, the facades of the buildings are not defaced by wires reaching from every direction in space. The wires are of like polarity as they reach the station, and as one and the other alternately loop to customers, there is rarely a difference of potential between the two circuits, where they approach each other, of more than that due to four lamps; and the difference is never enough to cause any of those deplorable accidents which sometime happen to careless workmen. After extending through the business portion of the city, the wires cross on another bridge and return to the lighting station.

—— THE TELEGRAPHIC AND TELEPHONIC PROTECTOR COMPANY, of Philadelphia, is a corporation recently organized, with a capital of $1,000,000, for the purpose of introducing the new scientific apparatus, from which it takes its name. The *Scientific Times and Mercantile Register*, says : that the "protector" was invented by Mr. M. D. Conolly, of this city, and is not only the best device for the purpose yet brought out, but the only completely automatic protector now known. Externally, with its two magnets and its knobs, it looks to the eye of the uninitiated, very much like a small telegraph instrument ; but it is really, as its name implies, an automatic protector, intended to divert or neutralize any sudden overplus of current; and, according to the testimony of electricians, guaranteeing entire immunity from the many accidents caused by a sudden excess of electricity where it is not wanted. From experiments made, it appears that the new invention, as long as the currents are normal, remains in quiet expectancy and vigilance, abstaining from all interference with the working of the instrument, telegraphic or telephonic, as the case may be ; but the moment its magnets become, so to speak, conscious that the passing current is abnormal, its wire instantly connects itself with the instrument, assumes the responsibility for the excess, and by the action and reaction of its magnets, neutralizes the same before it can do any damage. The numerous accidents that have already occurred in consequence of an excess in the electric current, render this little attachment a most timely and useful invention. Thorough tests have been made, both in New York and Philadelphia, and from all it has come out triumphant. At the Western Union offices in New York, thirty-two tests were made before the celebrated French electrician, M. De Imfreville, and Mr. G. C. Hamilton, another distinguished expert; all resulting most satisfactorily.

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—— WE HEAR MORE of the effects of the electric storm; and in addition to the phenomena already mentioned in previous issues, we have learned of so many instances of its effects upon electric light systems, that it is probable that there was not a public lighting circuit in New England, where it was not found necessary to reduce the number of dynamo machines upon circuits driven in series, or to diminish the speed of the armatures, in order to keep the lights in satisfactory condition. In Springfield, Mass., out of twenty-four wires in one telegraph office, it was rarely that over two could be used at any time In the central office of the Haverhill Telephone Co., the terrestial electricity kept the armature of the call to the magnet, so that no signals could be transmitted, because the alarm could not be used to notify persons. The terrestial current was not constant, and efforts which were made elsewhere, to neutralize it by a counter-current from batteries, were unsuccessful. It is, indeed, fortunate that no destructive fires were due to any effects upon the electric fire alarm systems, so that an alarm of fire was not signaled to the department. Yet, such results would have ensued, if fire alarms had been struck at certain times and places.

—— ON FRIDAY EVENING, February 16, about 300 gentlemen assembled at Hotel Vendome, Boston, by invitation of Spencer Borden, the Manager of the Edison Electric Company for the New England States, to listen to an explanation of the system, in reference to the formation of a company for lighting a district in Boston from a central station, similar to the one in New York. Major S. B. Eaton presented a clear and concise statement of the salient points in the Edison system of electric lighting. Without digressing into any comparisons with other methods of electric illumination, he gave some interesting facts relative to the Edison electric lighting station in New York. Since opening the station on the 4th of last September, the electricity has been continuously furnished, day and night. There were serious defects in the engines, which gave trouble at first, but they were not of an electrical nature, except so far as irregular speed of engines interfered with the uniformity of the current produced by the dynamos. Now, that new steam engines have been introduced, everything is satisfactory. The statement was made that the company had invested $1,750,000, and from a beginning of 85 customers, had reached 319 houses, which require 6,500 lamps, and the number is being increased daily, as fast as the wires can be installed by their men. Of the 40,000 gas burners in this district, 25,000 were used between 5 and 6 P. M. Mr. Spencer Borden exhibited maps of a portion of Boston, which it was proposed to light by Edison lights. In the district bounded by Bromfield, Tremont, Boylston, Kneeland, Kingston, and Franklin Streets, which is about 2,000 feet long, and 1,000 feet wide, are 34,000 gas jets, of which 24,489 are burned between 5 and 6 P. M. Less than 20,000 Edison lights would be the equivalent of these gas lights. This district contains one gas jet to every 90 square feet area, and is, therefore, expected to be a much richer district in probable returns than the New York district, where there is one light to 208 square feet, or about 43 per cent. as much light used over a given area. Short remarks were made by Mr. Thomas A. Edison, Mr. Henry Villard, and others. Statements of the finances of the central lighting station in New York, which were of a most satisfactory nature, were shown, but not for publication. It was announced that the policy of the Edison Company would be to begin the formation of lighting companies in the leading cities.

ILLUMINATION OF INTERNAL CAVITIES BY MEANS OF THE ELECTRIC LIGHT.

AT the last meeting of the Northumberland and Durham Medical Society, I exhibited Mr. Payne's improved electric light appliances, and showed how some of them might be employed for microscopical and clinical purposes. For the past few months I have been engaged with Mr. Payne in suggesting adaptations of these instruments to the purposes just alluded to. Remembering that Sir Henry Thompson, more than a year ago, explored the bladder by means of the electric light, and that Leitz, of Vienna, is devising instruments for illuminating the throat, posterior nares, bladder, uterus, &c., Mr. Payne made an instrument by means of which the throat could be examined. Having at the present time a patient in the infirmary who is suffering from hydatid disease of the liver, and on whom the operation of abdominal section with incision of the liver had been performed, took advantage of the opportunity and succeeded in lighting up the interior of the cyst by means of the electric light. For this purpose Mr. Payne devised and constructed a brass tube, electro-plated, nine and a half inches in length, and eleven-sixteenths of an inch in diameter externally. One end of this tube was funnel shaped, and the other was closed by a piece of glass; down this tube was inserted a narrow cylinder, which carried a Swan's lamp and the electric wires. This tube, with its glazed extremity, was smeared with carbolized oil (although in future I shall use carbolized glycerine for the window of the tube), and with gentle pressure I succeeded in passing it through the abdominal incision into the interior of the liver. The lamp was at once lit, and I had the pleasure of observing a grayish red condition of the wall of the cyst, studded across which, were numerous yellow-white spots, evidently pus; a slight oozing, or sweating, was also noticed on the wall of the cavity. The illumination of the interior of the liver by means of the electric light was in every way satisfactory and successful, and although it is of little aid in the treatment of the case in question, it has shown us that the lighting up of the internal cavities is not only a possibility, but a matter of comparative ease. With the extremely small size of the Swan's lamp required (it is not much larger than an ordinary bean), and which gives a light equivalent to that from three candles, and with the improved instruments which Mr. Payne is devising, I see how the electric light might become useful in operations for vesico-vaginal, or recto-vaginal, fistula, and in certain diseases of the bladder. Before making use of this illuminating endoscope on the human subject, I tried its effects in a dark chamber; I read with ease a piece of print placed therein.

MR. PAYNE'S REPORT.

Leiber's arrangemert contains an electric lamp in which platinum wire is heated by means of battery power and rendered incandescent. The arrangement I made is of much simpler construction, gives a perfectly pure light, and develops less heat. It consists of an electro-plated outer tube, nine inches and a half long by eleven-sixteenths of an inch external diameter, glazed at one end with a stout piece of plate glass made perfectly secure and tight.

A Swan's electric lamp is used, the filament of which is carbon and rendered incandescent by means of battery power. It is hermetically sealed in a glass shade; and water, conveyed to and fro through very small brass tubes, is made to circulate round the lamp. The light from this lamp is perfectly pure, and exhibits the conditions of things in their true and natural color. For prolonged observation, I should prefer to use either a Grove's or Bunsen's battery, but in the demonstration just referred to, four cells of a modified Leclanché battery were employed, and answered admirably. It is advisable to have as great a pressure as possible for the water supply, so as to insure perfect circulation, and for this I suspended from a hook, fixed near the ceiling of the room, a tin can containing water, connecting it with the brass tube by means of lengths of india-rubber tubing.—Thomas Oliver, M.D., M.R.C.P., Physician to the Infirmary, Newcastle-upon-Tyne, and J. B. Payne, F.R.M.S., Newcastle-upon-Tyne.—(*From the British Medical Journal.*)

BOOK NOTICES.

ALLISON'S WEBSTER'S COUNTING HOUSE DICTIONARY AND DICTIONARY OF ELECTRICITY. W. L. ALLISON, New York. Eighth edition. $3.00, post-paid.

The first mentioned work contains 384 pages, and is based on Webster's dictionary, of the same title. The extensive sale of this book, has made it so generally known, that we may omit particular reference to its worth. The Dictionary of Electricity, that is bound with it, would deserve especial attention from us, had it been compiled with the ability and fulness which the subject requires. The plan is undoubtedly good, and in the absence of any similar work, it may be of some use. Electricity is a young giant, as it were, that is still in his swaddling clothes. Its growth has been rapid, and any treatises on the subject will have to be revised at frequent intervals. To properly present the advancement and present state of the science, would require much labor, care, and the collaboration of eminent specialists. Frequent reference is made, in the present work, to prominent publications, and thus the searcher after information is at least given further directions. The volume is tolerably well printed, and is strongly and tastefully bound.

BUSINESS NOTICES.

A MECHANICAL ENGINEER, of twenty years' experience in the manufacture, construction and management of Maxim, stationary and mining machinery, wishes to connect himself with the Electric Lighting business, either in the manufacture or construction departments. References of the highest character given as to integrity, capacity, and ability.

Address MECHANIC, care of *Electrician.*

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CAUTION.

Certain statements having been circulated in reference to the Dynamo-Electric machine, made by us, which we call the **ARAGO RADIAL DISC DYNAMO,** and claims set up to the right to manufacture the same, independent of our control, we hereby inform all makers, purchasers, and users of the above type of Dynamo machines, that we hold certain underlying Patents on the same, and that no person or persons but ourselves have the power to grant licenses or rights to manufacture these Dynamo machines, and all parties are hereby cautioned against infringement of our Patents, by the manufacture or sale of the same.

The sale and use of these machines in the New England States, is in the hands of the Economic Electric Co., Boston, Mass.

For all other rights, address,

THE WHITE HOUSE MILLS,

HOOSAC, N. Y. ROBB MACKIE, Sec'y.

NOTICE.

AT a special meeting of the stockholders of the ELGIN TUBULAR IRON TOWER CO., of Elgin, Ill., held at their office, in the City of Elgin, pursuant to notice, on January 18th, 1883, at 10 o'clock a. m., the following resolutions were adopted:

Resolved: That the name of the ELGIN TUBULAR IRON TOWER COMPANY, of Elgin, Kane County, Ill., be, and the same hereby is, changed to that of the DETROIT TOWER COMPANY, of Detroit, Wayne County, Mich.

Resolved: That the general offices of the DETROIT TOWER COMPANY, as well as the business of the Company, shall be removed from Elgin, Kane County, Ill., to Detroit, Wayne County, Mich., an office being retained in Chicago.

Elgin, Ill., January 19th, 1883.

(Signed), GEORGE E. BOWEN, Secretary.

In pursuance of the above notice, we beg to announce that under the name and style of the DETROIT TOWER COMPANY, of Detroit, Mich., we shall continue the manufacture of

ELECTRIC LIGHT TOWERS,

(*Under the Adams Patents*),

and with our newly added facilities, are prepared to furnish Towers for lighting cities, villages, parks, railroad yards, docks, &c., &c., with the Electric Light, promptly and to the satisfaction of purchasers. The Electric Light has demonstrated the great economy in its use over any other light—and the Tower system to be the true way for its distribution, as the elevation of the light greatly increases its radial capacity. It is safe to say that a Tower 150 to 175 feet high, with six 2,000 C. P. Brush lamps, will light a radius of 2,000 feet. Cities that have introduced these Towers and the Electric Light are respectfully referred to as enthusiastic advocates of the Tower system, and its wonderfully pleasing results. They one and all testify to the utility, economy, beauty and strength of the Towers.

In the city of Denver, the Towers having withstood two fearful storms, Mr. W. B. Rundle, Manager of the Colorado Electric Company, in ordering two 150 feet Towers, to replace wooden ones blown down, says: "this will show you that the Tower system is not a failure in Denver." The cities that are now using our Towers, are Aurora, Ill., Topeka, Kan.; Fond du Lac, Wis.; Bay City, Mich.; Savannah, Ga; Fargo, Dakota; Fairfield, Iowa; LaCrosse, Wis.; City of Mexico, Mexico; Denver, Col.; Tipton, Iowa: Rock Island, Ill.; and many other cities are considering the introduction of the light by means of the Tower system. Railroad managers are specially requested to examine this system for lighting their yards and depot grounds. The people say: "Let there be light!"

PRICE LIST OF TOWERS FOR ELECTRIC LIGHTING.

Height in Feet to Lamps.	*Towers, Plain, with Fixed Lamps.*	*Towers with Elevators.*
54	$300	
70	350	
86	425	
102	500	$650
134	850	1,000
150	1,050	1,200
168	1,500	1,650
200	1,800	2,000
250	2,650	3,000

Prices are given for the Towers delivered on board the cars in Detroit—freight to point of Destination added. The ordinary cost of erection is included in Price List. Foundations extra.

Estimates given for Towers of any height, and any information very cheerfully furnished on application. Correspondence is solicited.

DETROIT TOWER COMPANY,

88 Griswold Street,

DETROIT, MICH.

GEORGE S. BOWEN, Manager.

Chicago Office, No. 5 Ogden Building.

PATENTS FOR JANUARY AND FEBRUARY, 1883.

JANUARY 23d.

270,884 Electric Battery, Fluid. E. Berliner, Boston, Mass.
271,169 Electric Induction Machine. A. G. Waterhouse, New York, N. Y.
271,172 Electric Light. E. Weston, Newark, N. J.
271,140 Electric Light and Gas Burner Combined. W. A. Shaw, Brooklyn, N. Y.
271,175 Electric Motor. S. S. Wheeler, C. G. Curtis, and F. B. Crocker, New York, N. Y.
270,954 Lamp, Electric-arc. C. P. Jürgensen, Copenhagen, Denmark.
271,173 Lamp, Electric-arc. E. Weston, Newark, N. J.
271,171 Lamp, Incandescent, Electric. E. Weston, Newark, N. J.
271,059 Lamp, Magazine Electric. A. T. Gifford, Providence, R. I.
270,907 Telegraphs, Optical Attachment for Printing. W. J. McCausland, Philadelphia, Pa.
270,990 Telegraphy, Multiplex. C. Selden, Toledo, Ohio.
271,188 Telephone Receiver. S. H. Bartlett, and H. E. Waite, New York, N. Y.

JANUARY 30th.

271,560 Electric Circuits, Device for Making and Breaking. R. W. Willson, New Haven, Conn.
271,502 Electric Motor. A. Millar, Glasgow, Scotland.
271,299 Galvanic Battery. J. A. Barrett, Chicago, Ill.
271,395 Lamp, Electric-arc. E. H. Amet, La Grange, Ill.
271,576 Lamp, Electric-arc. J. R. Finney, Pittsburg, Pa.
271,456 Lamp, Electric-arc. W. Hochhausen, New York, N. Y.
271,458 Lamp, Electric-arc. W. Hochhausen, New York, N. Y.
271,302 Lamp, Incandescent Electric. A. Bernstein, Boston, Mass.
271,457 Lamps, Automatic Cut-out for Electric. W. Hochhausen, New York, N. Y.
271,548 Telegraph Cable, Submarine. S. Trott and F. A. Hamilton, Halifax Nova Scotia, Canada.
271,262 Telegraph Cable Pipe. W. R. Patterson, Chicago, Ill.
271,279 Telephone Exchanges, Circuit for Multiple Switch Boards for. C. E. Scribner, Chicago, Ill.
271,324 Telephone, Mechanical. G. K. and H. C. Farrington, Kirksville, Mo.
271,513 Telephone System and Apparatus. C. A. Randall, New York, N. Y.
271,280 Telephones, Secrecy Switch for. C. E. Scribner, Chicago, Ill.

FEBRUARY 6th.

271,707 Annunciator and Fire Alarm, Electric Hotel. A. T. Hess, Des Moines, Iowa.
271,721 Brake Setting Apparatus, Electric. J. B. Low, Pulaski, N. Y.
271,882 Car Signal, Electro-magnetic. J. W. Marley, Chicago, Ill.
271,825 Electric Circuit Wires, Fastening for. H. G. Fiske, Springfield, Mass.
271,948 Electric Current Regulator. E. Thomson, New Britain, Conn.
271,972 Electric Machine, Dynamo. W. Baxter, Jr., Jersey City, N. J.
271,979 Electric Machine, Dynamo and Magneto. E. Gordon, New York, N. Y.
271,928 Electric Machine, Dynamo and Magneto. C. A. Seeley, New York, N. Y.
271,615 Electric Machine Governor, Dynamo. T. A. Edison, Menlo Park, N. J.
271,616 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
271,654 Electric Machine Regulator, Dynamo. J. F. Ott, Newark, N. J.
271,947 Electric Machines, Commutator for Dynamo. E. Thomson, New Britain, Conn.
271,913 Electric Switch Board. T. J. Perrin, Brooklyn, N. Y.
271,882 Electrical Conductor. P. G. Gardner, Jr., J. W. Le Roy, and G. K. Tinker, North Adams, Mass.
271,914 Electrical Switch Board. T. J. Perrin, Brooklyn, N. Y.
271,805 Gas Lighting Burner, Electric. C. H. Crockett, Boston, Mass.
272,001 Gas Lighting Burner, Electric. H. J. Warren, West Bridgewater, Mass
271,991 Incubators, Electric Regulator and Alarm for. F. Rosebrook, Elmira, N. Y.
271,994 Insulator, Electrical. D. M. Steward, Cincinnati, Ohio.
271,816 Lamp, Electric-arc. W. L. Dudley, Covington, Ky., C. F. Rapp, Cincinnati, Ohio.

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271,618 Lamps, Manufacture of Incandescing Electric. T. A. Edison, Menlo Park, N. J.
271,733 Lightning Rods, Triprod Standard for. T. H. Patee, and T. D. Ridge, Greencastle, Ind.
271,904 Mail Conveyer, Electric. E. Nicolaisen, New York, N. Y.
271,628 Secondary Battery. A. Haid, Rahway, N. J.
271,958 Telegraph, Railway Train. W. T. Waters, Atlanta, Ga.
271,597 Telegraphs, Station Switch for Fire. G. F. Bulen, Jersey City, N. J.
271,598 Telegraphic Fire Alarm Stations, Automatic Testing Apparatus for. G. F. Bulen, Jersey City, N. J.
271,876 Telephone. C. T. Loring, and G. W. Pierce, Boston, Mass.
271,610 Telephone Receivers, Circuit Closer for. E. C. Dean, Washington, D. C.
271,924 Telephone Transmitter. E. A. Schoettel, Brooklyn, N. Y.
271,903 Telephone Transmitters, Mouthpiece for. A. S. Nichols, New Haven, Conn.
271,750 Wire, Manufacture of Covered or Insulated. J. D. Thomas, New York, N. Y.

FEBRUARY 13th.

272,100 Clock, Electric. D. F. Sweet, Hastings, Mich.
272,256 Electric Machine, Dynamo. E. J. Houston, Philadelphia, Pa.
272,366 Electric Machine, Dynamo. E. Weston, Newark, N. J.
272,365 Electric Transmission of Power, System for the. E. Weston, Newark, N. J.
272,221 Electric Wires, Underground Conduit for. J. S. Du Bois, Camden, N. J.
272,362 Electrical Transmission of Power, Device for Regulating the. E. Weston, Newark, N. J.
272,363 Electrical Transmission of Power, Device for Regulating the. E. Weston, Newark, N. J.
272,364 Electrical Transmission of Power, Device for Regulating the. E. Weston, Newark, N. J.
272,353 Electro-magnetic Retarding Device. E. Thomson, New Britain, Conn
272,169 Electrolier, Extension. L. Stieringer, New York, N. Y.
272,187 Gas Generator, Electric. C. E. Ball, Philadelphia, Pa.
272,069 Insulator for Electric Conductors. T. Mace, Plainfield, N. J.
272,262 Lamp, Electric-arc. N. S. Keith, New York, N. Y.
272,367 Lamp, Electric-arc. E. Weston, Newark, N. J.
272,125 Lamp, Electric Incandescent. P. Diehl, Elizabeth, N. J.
272,017 Lamps, Carbon Electrode for Electric. J. E. Atwood, Troy, N. Y.
272,234 Magneto-electric Generators, Automatic Shunt for. E. T. Gilliland, Indianapolis, Ind.
271,142 Railway Signal, Electric. W. W. Le Grande, Louisville, Ky.
272,276 Railway Signal, Electric. W. W. Le Grande, Louisville, Ky.
272,210 Telegraphic Relay. T. Cochran, Brooklyn, N. Y.
272,034 Telephone. T. A. Edison, Menlo Park, N. J.
272,329 Telephone, Electric Speaking. A. W. Rose, and C. A. Cheever, New York, N. Y.

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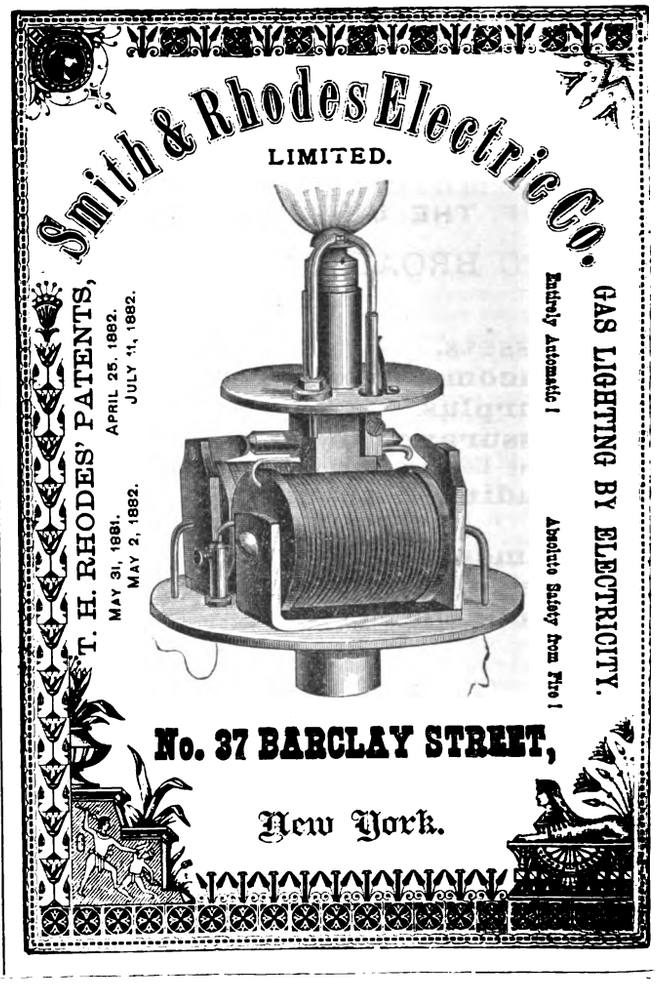

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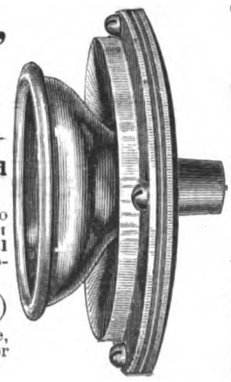

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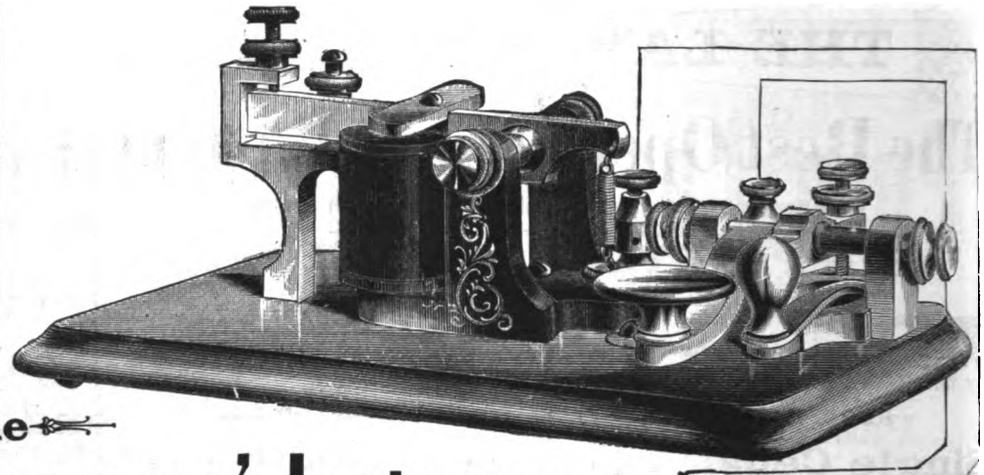

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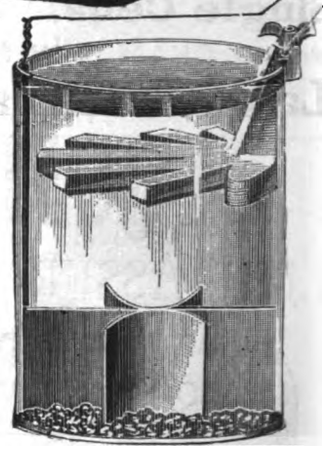

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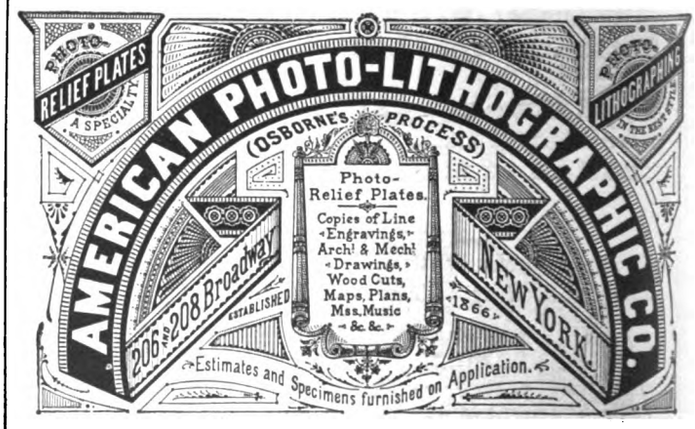

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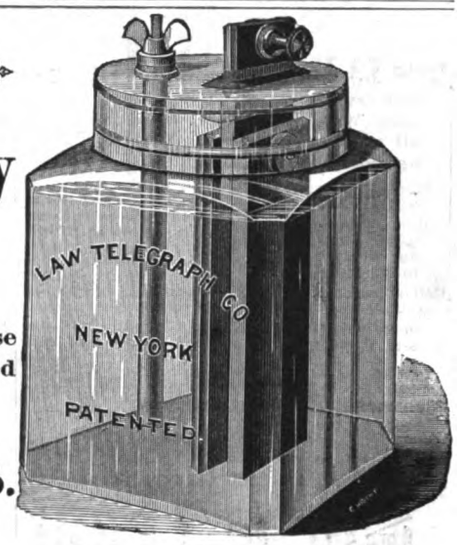

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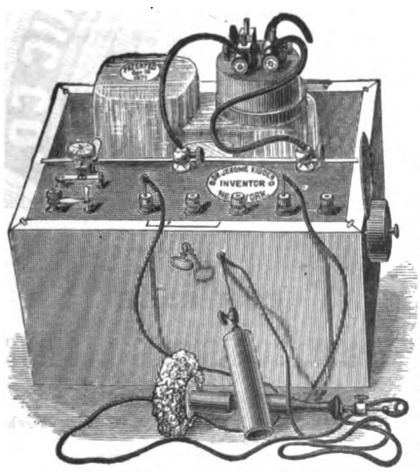

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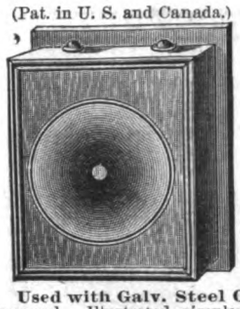

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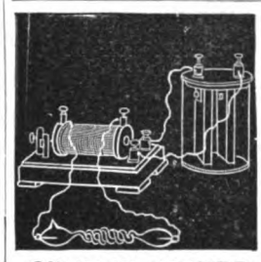

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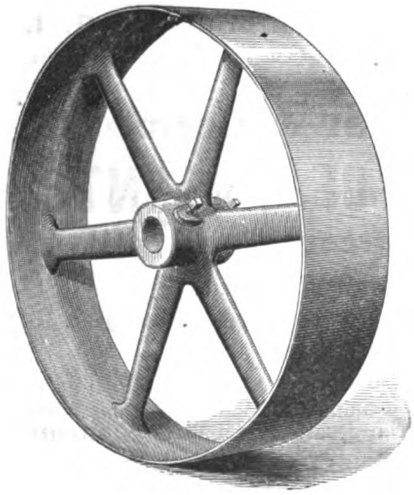

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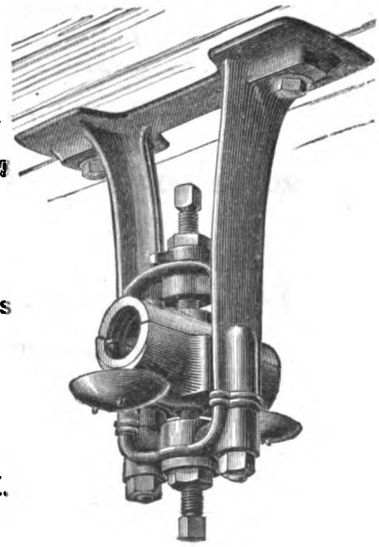

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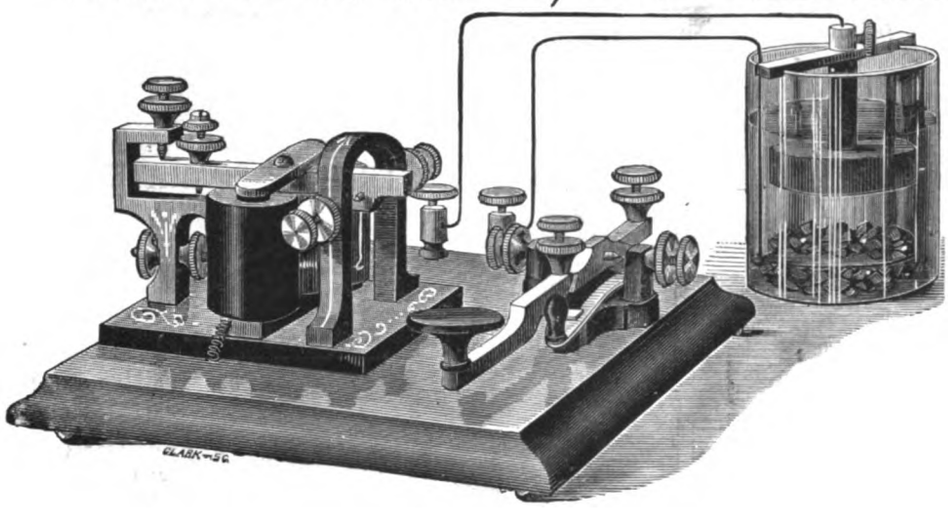

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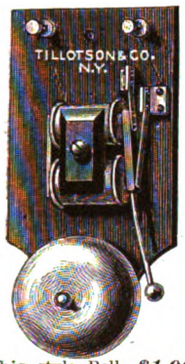

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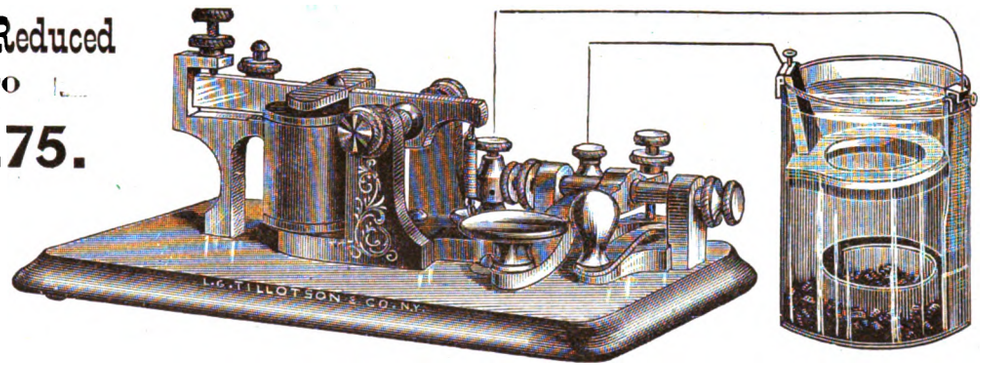

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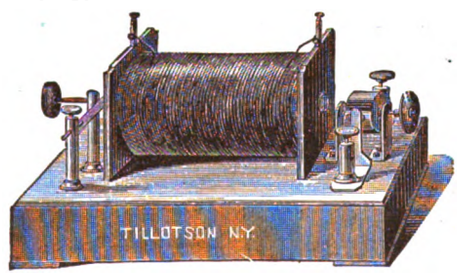

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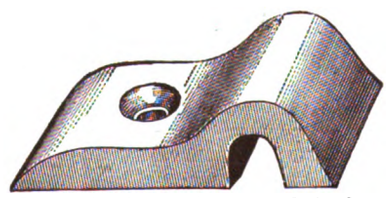

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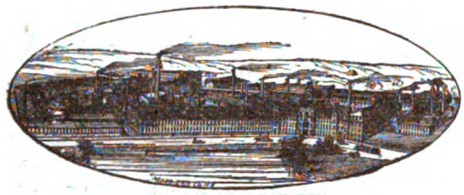

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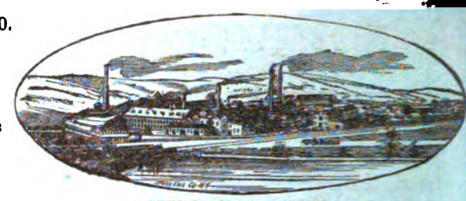

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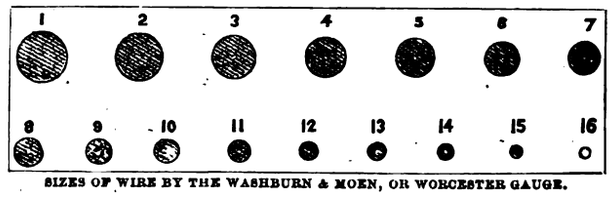

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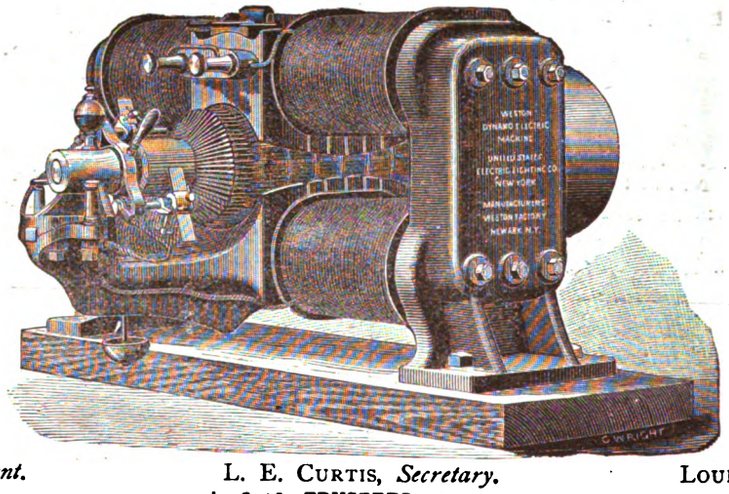

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THE ELECTRICIAN

A JOURNAL OF ELECTRICAL SCIENCE

Richardson, N.Y.

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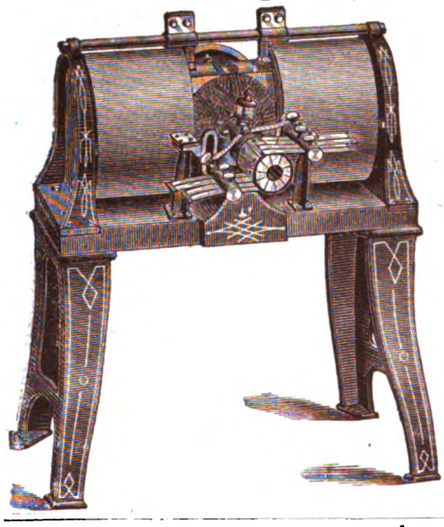

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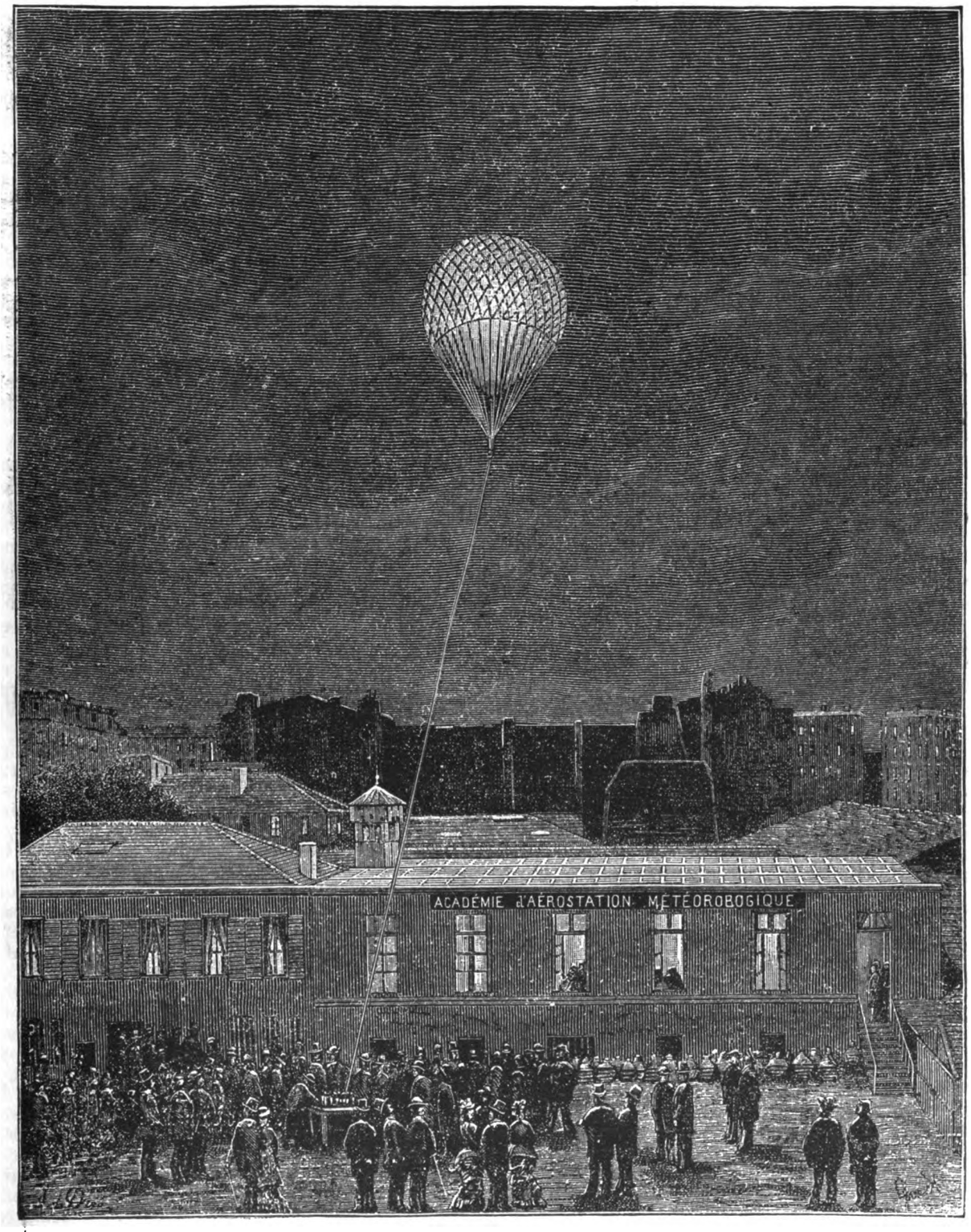

SIGNALING BY ELECTRIC LIGHT.—See page 94.

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ELECTRICITY APPLIED TO BALLOONS.

THAT a great many important objects may be obtained by the combined use of electricity and balloons, can no longer be doubted. In the first place, a balloon can ascend to any desirable height, and thus the electrical focus can attain a far higher elevation than even the tall pole of Union Square. That measures could be adopted to anchor the balloon even on the most stormy night can neither be gainsaid. The striking illustration on our front page, from *La Lumière Électrique*, represents an experiment in the above direction, made lately at La Chapelle, France.

The balloon was made luminous by an incandescent Swan lamp,—the experiment being under the direction of an aeronaut, M. Mangin. The balloon was made of water-proof paper; its diameter measured about eight feet. It was filled with pure hydrogen gas, while a Swan lamp was hung in the centre, with wires connecting it with a pile of twenty-four elements, and placed on a table, as shown in illustration.

When the inflation was judged to be sufficient, the lower opening was closed, and as the current traversed the conducting wires, the electric focus became incandescent, and the balloon was transformed into a vast luminous globe, which illuminated the surrounding buildings in the most magnificent manner.

It was at once perceived, that this new kind of aerial illumination possessed great advantages for signaling, as the current can be intercepted or restored instantaneously. The illuminated mass can be seen at a great distance, and it can be made serviceable both to forces on land and sea. An enemy's fort or camp can be investigated, while the rapid interception of current and extinction of light would prevent any locating of the balloon itself.

M. Mangin has even declared his intention to do away with the connecting wires; he would simply have an electro-magnetic machine in the balloon, which could be worked by hand. The presence of the inflating gas constitutes a great danger, however, for any mishap to the conducting wires would lead to a catastrophe.

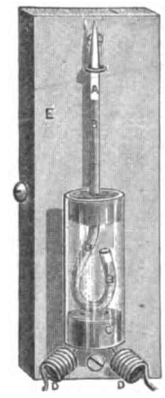
Messrs. Tissandier, who have also given great attention to aerial navigation, have constructed light piles with bi-chromate of potash, composed of twenty-four elements united in tension, for working an electro-magnetic motor which will in turn work the aerial screw of an elongated balloon. Experiments with Siemens Brothers' motor were made in January, and proved that a velocity of from four to five yards per second could be imparted to the aerial ship.

—— THE *London Times* says: The electric light has been applied of late in various cases, where the effect has been singularly picturesque. Thus, during a congress of Greek medical men at Athens last year, several electric lamps were placed at elevated points about the Acropolis, and the aspect of the ruins so lit up is said to have been very striking. The Company of Steam Navigation on the Rhine and the Lake of Constance started last year a night service of steamers supplied with Bürgin electric lamps, to illuminate the beautiful banks of the river. The steamer left Schaffhausen at fall of night, and sailed to Biesingen, and passengers were enabled to enjoy the scenery in those novel circumstances. Further, the falls of the Rhine have been illuminated at night, by a powerful electric light placed on the right bank. To appreciate fully the remarkable appearance of the foaming torrent so lit up, it is necessary to reach the principal rock, on which is a small pavilion, and where the stream divides into two large parts. Again, there is a regular night service instituted between Cannes and the Lerin Islands, the vessel being the steam yacht "Cannois," which has a powerful Mangin lamp, also thirty-four Swan lamps, arranged between the masts and elsewhere. The electric light guides the course in the difficult navigation which often occurs in these trips, and furnishes many lovely views of scenery.

A NEW THERMOSTAT.

AT a meeting of the Society of Arts, held at the Institute of Technology, Boston, Mr. F. C. Childs described the new thermostat of the Automatic Fire Alarm Association of that city.

The object of the device is to close an electric circuit by means of a slight increase of heat, and its present application is to give an alarm of fire by ringing an annunciator which indicates in what room the danger exists.



A. Hydro-carbon.
B. Mercury.
C. Insulator.
D. Conducting Wires.
E. Base-board.

It differs from the well-known devices—containing a compound bar of steel and brass, which deflects with change of temperature—and closes a circuit by using the vaporization of a hydro-carbon to serve this purpose.

Referring to the illustration, it will be seen that this instrument consists of a glass U-tube, with arms of unequal lengths (the longer arm being closed), and projects from a cup which contains the tube.

The upper arm of the U-tube contains a small amount of hydro-carbon liquid, and the remainder is filled with mercury.

The lower part of this cup is made of hard rubber or some other insulating material, and holds the two poles of the circuit, one of which enters the cup through a hard rubber screw, and the other is connected to the base of the cup.

When the temperature exceeds any fixed limit, a small amount of the hydro-carbon is vaporized, and its expansion forces out some of the mercury which collects at the bottom of the cup, and forms an electrical connection between the two poles and completes the circuit.

The thermostat is five and a half inches high, and one and a half wide; and when placed in position, an ornamental metal covering renders it sightly and protects it from injury.

If it should be tampered with, or broken, the accident would spill enough mercury into the cup to sound an alarm.

This instrument does not require any mechanical nicety of adjustment, as the temperature at which the alarm will sound depends wholly upon the boiling point of the hydro-carbon used.

As there are a regular series of liquid products of petroleum which vaporize at points from the lowest artificial cold to 600 degrees Fahrenheit, there are no obstacles from that source. For most places a liquid which vaporizes at 118 degrees is used.

This thermostat is more sensitive than is possible in any apparatus operating by the expansion of metals, because the quantity of heat necessary to raise a certain volume of a hydro-carbon a certain number of degrees, is less than the quantity of heat required to elevate the temperature of an equal volume of metal to a corresponding increase in temperature.

The operation of this thermostat depends upon the vaporization of an almost infinitesimally small quantity of the liquid; not more than .000002 of a cubic inch. The heat absorbed in raising the temperature and converting into vapor this small amount being about .00001 of a thermal unit.

To raise the temperature of the mercury in an ordinary thermometer, the range which would be required for the operation of the thermostat, say from 60 to 120 degrees Fahrenheit, would require a much greater quantity of heat. If the mercury in the bulb weighed one-tenth of an ounce, or .00625 of a pound, the increase of temperature being 60 degrees and the specific heat of mercury being .0333,

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then the quantity of heat necessary to raise the mercury in the thermometer 60 degrees, would be

.00625 x 60 x .0333=.01249 of a thermal unit, being 1,249 times the quantity of heat required for the thermostat.

As a matter of fact, with experiments made by exposing these instruments to quick fires, their operation was so rapid that the thermometers gave no indication of the exact temperature at which the thermostat closed the circuit.

The speaker gave detailed accounts of tests of this apparatus in places where it was in use; and in the presence of the audience ignited a piece of newspaper, and the thermostat caused an alarm to be rung in thirteen seconds.

The Parker House, in Boston, is provided with 300 of these thermostats and they are to be placed in other hotels, and also in a number of manufacturing establishments.

NEW GALVANO-CAUTERIZING BATTERY.

GALVANO-CAUTERIZING operations are becoming more and more frequent, and we believe not without reason, for in many respects the method presents incontestable advantages, which, however, it is not our purpose to discuss at present, but its direct dependence upon the manner of generating the electric current is a matter not unsuited to our present attention.

The inconveniencies of this method are all exterior and material; they include the transportation and manipulation of the battery, both of which frequently cause the spilling of its corrosive liquid contents, which damage whatever they may fall upon.

Mr. Chardin, an ingenious constructor of electrical apparatus, especially as applied to medical and surgical operations, some time ago devised a battery expressly intended to operate the instruments in galvano-cautery, which, it seems to us, is likely to be a valuable auxiliary.

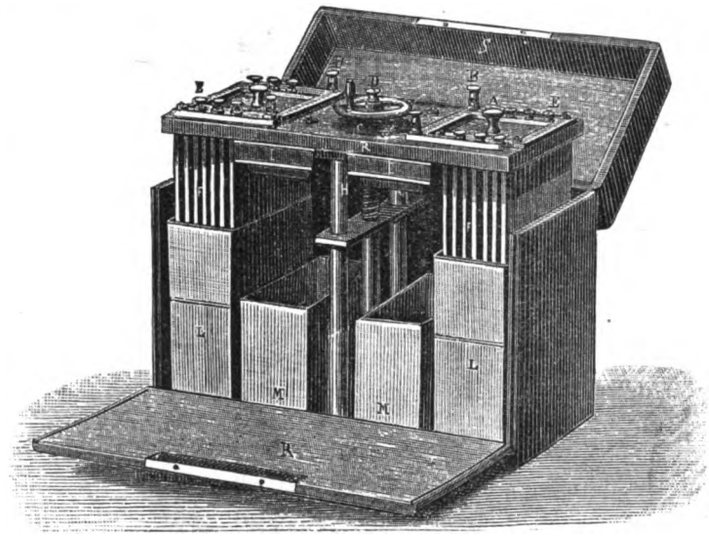
This battery is so constructed that an easily portable box contains all its parts, ready to act without fear of the liquid being spilled. In a few moments the whole apparatus is ready for use, in even less time it may be re-packed in readiness for removal.

It consists of a box, the cover of which S, and one side R, open upon hinges. Across the middle of the box three hollow columns, united at their upper ends by a horizontal bar, are fixed vertically in a line. The two outside columns are highly polished inside, to admit movable cylinders HH, fixed at the top to a metallic cross-piece, which is supported at any height by a screw tapped into the middle column. Upon the metallic cross-piece, thus supported by the screw and guided by the cylinders HH, a wooden table, as large as the inside of the box, is fixed, from the under side, of which the plates of the battery depend in the usual manner. Through the centre of this table the shaft of the screw passes, and terminates in a wheel and handle C. By turning this wheel, the table may be raised or lowered at pleasure.

The plates of the battery consist of carbons and zincs, three zincs and four carbons being suspended from each side of the table. These occupy but about half the space upon each side. In the unoccupied spaces below the table are fixed two covers of india-rubber I, I. The apparatus is completed by four ebonite troughs of the same size in plan, and all placed in the box at the same time. But they are of different heights, two of them LL, which contain the exciting liquid (a mixture of bi-chromate of potash and sulphuric acid), being as high as the box, while the other pair MM, are only half as high.

When it is desired to set the battery in operation, the plates are raised by the screw, and the troughs LL, half full of the acid, are placed in the position shown, their exact situation being assured by placing the half troughs MM, in their places, as also shown in the Fig. Reversing the screw, lowers the zincs and carbons into the liquid with a motion so gentle that no splash can occur. The current is regulated by raising or lowering the plates in the acid.

The operation ended, the table with its plates is raised by the screw until the plates are clear of the troughs LL, which may then be removed, and the half troughs MM, slid sideways into their places. The troughs LL, are then put in the places occupied (in the Fig.) by the half troughs MM, and the table is then lowered by the screw. The rubber covers I, I, then fit upon and close the acid reservoirs, and, by the screw, may be so tightly pressed upon them as to close them hermetically, and the box may then be shut, and safely transported. No acid can spill from the hermetically sealed reservoirs, and the drip from the plates is caught in the half troughs under them, and thereby prevented from injuring the apparatus in any way.



Without wishing to advance this arrangement as an invention of the first order, it seems to us that it displays an ingenuity, and acquaintance with practical requirements, deserving of recognition. Although proposed but a short time ago, it has been adopted by the hospitals at Lyons, Montpelier and Brussels, and if we are not mistaken, it is also used in the Bichat Hospital, in Paris. It appears effectually to obviate the inconveniences which attend the employment of the batteries previously used.

The zincs and carbons are about 5½ inches square. The three zincs and four carbons on each side are combined for quantity, so as effectually to constitute two large single plates. Binding posts, conveniently situated, permit the use of one or the other set of plates at pleasure, or if it be desired, the two separate batteries may be connected in tension, by a wide metallic band. The carbons are platinized. At their upper part they are covered with a coating of electrolytically deposited copper, to which is soldered the metallic sheet, which unites the four carbons of each element into one single plate. This arrangement assures the continuity of the contacts, and thereby maintains constant the resistance of the battery.

It is apparent that this apparatus can give neither more nor less than any other bi-chromate of potash battery, but from the point of view of its intended use, it can serve a desirably long time. The raising and lowering of the plates may be easily and frequently performed during the continuance of the surgical operation, and thereby may be avoided, the polarization which so soon occurs, when the plates remain quietly in the liquid. In all other respects it corresponds to the batteries now in use. C. M. G. in *L'Electricien.*

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DOMESTIC ELECTRICITY.

MAGNETIC telephones are specially adapted for small distances, and for places where telephonic conversation is not disturbed by outside noises. For workshops, &c., pile transmitters are far preferable on account of their greater power and distinctness. A few words on the pile transmitter and receiver will be in place before treating of the arrangement of the stations.

PILES.

We give the preference, in all cases, to the Leclanché pile for telephonic purposes. The new elements, with agglomerated plates, are much superior to the old elements with porous vase, which exercised an injurious influence by its greater interior resistance. It must not be forgotten, however, that the Leclanché elements are polarized when they are kept in closed circuit on the telephone for a certain time, and for this reason communication with the circuit should be cut off when the conversation is finished.

TRANSMITTER.

There is no end to the variety of telephonic transmitters, although when first invented they were divided into two classes only: Carbon transmitters and microphones. This, however, is altogether an artificial classification, for it is difficult, with all the various apparatuses at present in use, to make any such distinction. We will, therefore, use the general name of transmitter as applicable to any apparatus which is susceptible, under the influence of sound, of modifying its electric resistance in an undulatory and concordant manner with the vibrations of the said sound.

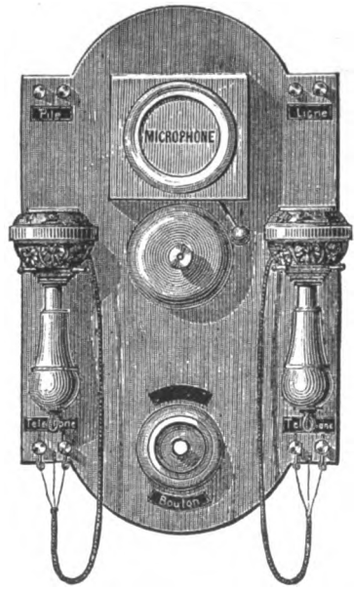

FIG. 1.—DUNAND'S TELEPHONIC STATION.

The simplest telephones are the best, and above all, those that one makes oneself with a few carbon crayons. The simplest transmitter is the Hughes' microphone—it is even too sensitive, and the "sputterings" that follow loud sounds are owing to this delicacy, which has to be reduced. This can be done in various ways: By inclining the board supporting the carbon cubes until it is perfectly horizontal or slightly sloping, or by putting a small folded paper in V shape between the board and the carbon crayon. In the transmitter of Locht-Labye, to which the inventor has given the pretentious name of *pantelephone*, the variable resistance contact is made between a stationary piece of platina and a small carbon lozenge glued to a sheet of cork that is suspended by two springs. The sheet of cork having little inertia and a large surface, follows the voice very satisfactorily.

In the last *electrophone* of M. Maiche—at least in the last one which we have seen—the contact is made between a carbon lozenge, fixed on a vibrating plate, and a carbon ball, which is suspended from a vertical lever, and giving a certain pressure that can be regulated by a counterpoise.

A very simple transmitter is thus described by M. d' Argy: Take a small board of walnut, pine, ebonite, or a Japanese screen, and fix it upright in a socket by means of two corks. Fix two pieces of carbon in the middle of the board, and put a pinch of coke between them. The coke can be kept in position with a piece of india-rubber tube of a feeding bottle. The vibrations of the board react on the contact formed by the powdered coke. All these simple apparatuses are with single or double contact. A method which gives very good practical results is to *multiply* the contacts, and to group them, either *in tension*, as in the ball microphone of Boudet, of Paris, or *in quantity*, as in the transmitter of Bert and Arsonval.

In Ader's transmitter there are ten carbons, giving 20 contacts, 4 in tension and 5 in derivation; Crossley's transmitter contains 4 pencils, 8 contacts—4 in tension and 2 in quantity; the Gower-Bell has 6 pencils, 12 contacts—4 in tension, 3 in quantity, &c.

To obtain satisfactory working with all these systems, the number of elements must be in proportion to that of contacts and their arrangement. If the contacts are in tension the elements must be put in tension, and the same rule for quantity.

The rule is: To have the interior resistance of the pile as near as possible to the average resistance of the transmitter.

FIG. 2.—ADER'S PORTABLE TELEPHONE.

RECEIVERS.

These are all, more or less, on the original model of Bell's, and are based on the electro-magnetic actions, with the exception of the condensators which have not yet come into use. The systems generally used are those of Bell (ordinary and watch); the Trouvé, Maiche, Phelps, Ader, and that of Arsonval. The last three are doubled pole, like the magnetic telephones of Gower and Siemens. When the distances are not too great an ordinary bell will be found sufficient. The size of the wire round the coils depends on the distance and mode of working.

WORKING.

A transmitter can actuate a telephonic receiver in two ways: 1, Directly, without the intermediary of an inducting coil; 2, Indirectly by an inducting coil. The first method can only be used for very short distances—in a room for instance, and with a relatively large telephone. It can be easily understood that as the line increases, the total resistance of the circuit that is constituted by the pile, the transmitter, the receiver and the line is also increased, while the variations in resistance of the transmitter always maintain their absolute value.

The effect of these variations will be, therefore, so much less as the distance is greater; it soon becomes insufficient and then the sounds are no longer perceptible. This is not exactly the case with the induction coil system.

The transmitter works on a circuit of constant resistance which is constituted by its resistance proper, that of the pile, and of the primary circuit or coil inductor, while the receiver and the line are connected with the inducted circuit of the coil or secondary circuit. In these conditions the

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influence of the length of the line is indirect, and it can always be reduced to a certain extent by using inducting coils and wire receivers, which are finer in proportion as the line itself is longer. Most of the telephonic stations are now furnished with inducting coils, and work perfectly to a distance of from 7 to 15 miles, and often further.

TELEPHONIC STATIONS.

For private or home telephony, we have usually two stations, connected in a permanent manner, as a factory and an office; a residence and gate-house, etc. When there are more than two stations, the telephonic connections form a regular system with a small central office, and any description of it would be out of place here. As pile telephones are generally only for short distances, not more than two wires must be used—even one only, is mostly used, the earth forming return wire.

For such purposes as we have mentioned, commutators must be used, so that, while *waiting*, the line will correspond with the bell work. When a *call* is made, the pile of the calling station communicates with the line, and during the time of *communicating, or talking*, the telephonic instruments are in mutual relation by the intermediary of the line.

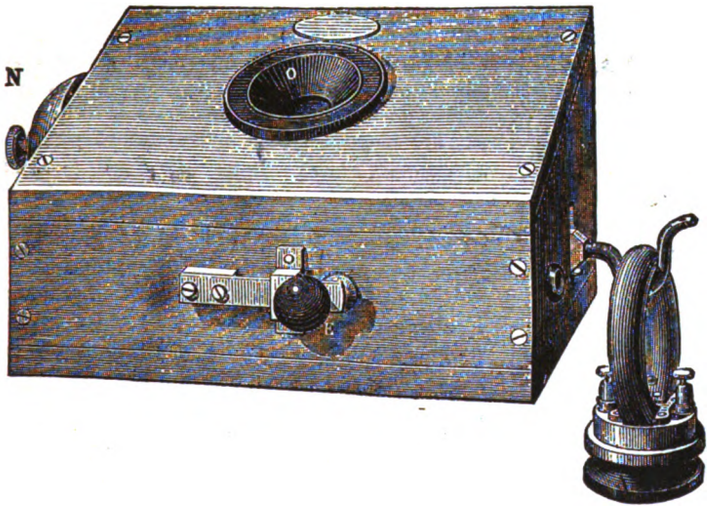

FIG. 3.—CROSSLEY'S TRANSMITTER: *O*, MOUTH-PIECE; *E*, CALL BUTTON; *R*, RECEIVER; *N*, BELL WORK.

The telephone station of M. Ducretet, was one of the earliest combined systems for this purpose, but its arrangement is such, that it is not easily worked, and even experienced hands make frequent mistakes with it. All communications are made by using a commutator with handle, that is placed, according as the case may be, on the call, the bell work, or the telephone.

The automatic commutators are far preferable; the accompanying illustrations will show the mechanism of some of the most popular. All these stations are on the principle that the speaker will leave his telephone hung on the hook as long as he does not want to speak, and that he will return it to its place when the conversation is over. A gentleman has, however, found a device for neutralizing the consequence of any forgetfulness. He fixes the cord, that suspends the telephone from the automatic commutator, in such a way, that even if the telephone is not put back in its place, the weight of the apparatus on the cord will have the same effect, as to the automatic commutation of the communications, as if it had been.

Each station is furnished with: 1, a pile of a few conglomerated Leclanché elements, that can be used both for working the call bell and the transmitter; 2, a call bell work; 3, a call button; 4, a transmitter; 5, an inducting coil, generally concealed in the socket or box; 6, one or two receiving or magnetic telephones.

In the telephonic apparatus of Dunand, Fig. 1, all the instruments are symetrically grouped on a board, from which two wires start to the pile, and two to the line. The microphone of this system is fixed on the box of the bell works; the call button is on the lower part, and the receivers are two Bell telephones, (Trouvé model). The automatic commutation is produced by working the *right* telephone. In Crossley's telephone, Figs. 3 and 4, the call button is in front of the box which

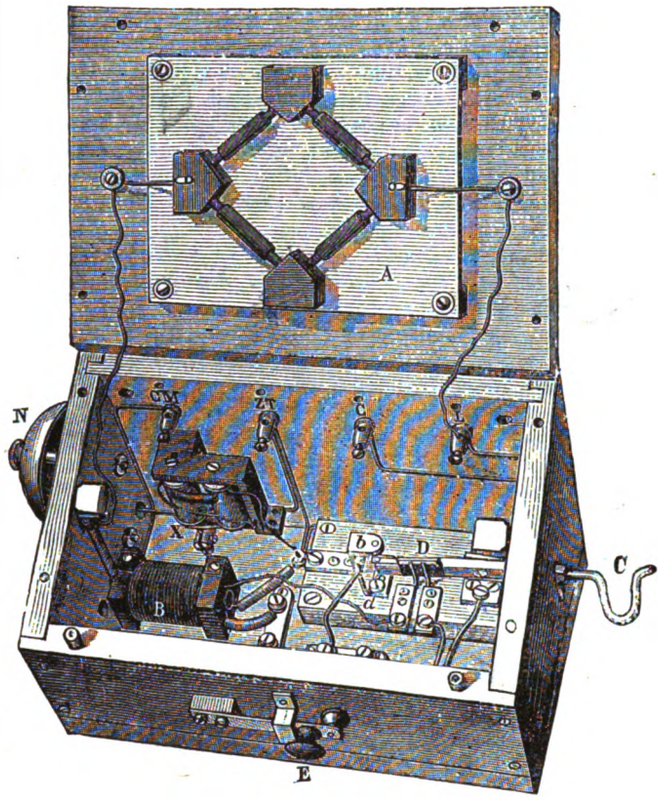

FIG. 4.—CROSSLEY'S TRANSMITTER (INSIDE VIEW): *A*, MICROPHONE; *D*, COMMUTATOR; *B*, INDUCTING COIL; *X*, ELECTRO-MAGNET OF BELL WORK.

contains the whole system—the bell work in *N*, towards the left; the hook commutator in *C*, to the right; and the mouth-piece in the upper part. The arrangement of the carbon lozenges and their grouping in two derivations—each comprising four contacts in tension—may be seen in *A*, Fig. 3.

A very practical model is the Ader portable telephone, Fig. 2. The foot bears the call button, the transmitter, which is in the shape of a desk, and the two Ader receivers. Elastic wires of suitable length form a tress which makes a connection between the pile, the bell work, (which is placed at any point in the room) and the line, and allows a certain displacement of the transmitting apparatus.

In a telephone station, recently invented by Messrs. Paul Bert and d'Arsonval, the carbon pencils of the transmitter are surrounded with a small sheet of tin, a magnet placed at a distance actuates the sheets according to the distance, and thus furnishes a magnetic regulator, and lets the transmitter work in any position. This regulator has enabled M. d'Arsonval to construct a transmitter which can be held in the hand, while the other pieces composing the station are put in a small box, that is hung on the wall. All these systems, and many others, will be found serviceable if properly used.

E. HOSPITALIER, in *La Nature*.

—— THE RESULTS OF THE changes in the arrangement of the particles of matter, by magnetic and electrical action, can be seen in a dynamo which has been in use a long time. The iron of the magnets is comparatively soft near the poles, and the wires near the magnet are quite soft. Repeated magnetization increases this molecular change, and also adds to the magnetic capacity of the iron. It is well-known that an old dynamo is of higher efficiency than a new one.

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THE INVENTOR OF THE TELEPHONE.

THE following letter, from Silvanus P. Thompson, on the invention of the telephone, appears in the London *Electrician* of March 10.

To the Editor of the Electrician.

SIR:—As your editorial note of p. 374 invites me to give the references that I have indicated in evidence of Reis's claim to be the inventor of the telephone, which he designed for the express object of transmitting human speech and other sounds of all kinds, I have much pleasure in giving you the very same references which I have myself obtained from the published writings of Graham Bell ("Researches in Telephony," *Journal of Society Telegraph Engineers*, 1877), and of Edison (see "Prescott's Speaking Telephone," p. 218).

1. "Telephonie," *Dingler's Polytechnisches Journal*, CLXVIII., p. 185, extracted from the *Jahresbericht des Physikalischen Vereins zu Frankfurt am Main*, 1860-'61, p. 57-64.

This is a scientific memoir by Philipp Reis, having for title "On Telephony by the Galvanic Current" On p. 58, he says his endeavor was to find an instrument which should reproduce the total action of all the organs set in action in human *speech* (menschlichen Spräche), and that he took the human ear as model, because the tympanum of the ear could respond to all sounds. After discussing the problem of representing the pressures of the air in sound waves by a "curve," he says, that if it is possible at any place to reproduce vibrations having a similar "curve," the very tones will be reproduced. He then says, that taking his stand on the principles laid down, he has succeeded in reproducing the tones of various instruments, and, to a certain degree, the human *voice* (die menschliche Stimme). After describing his instrument—the well-known combination of a tympanum, in imitation of that of the human ear, with an electric current regulator, consisting of an interrupting apparatus, which embodied the loose contact principle of the microphone, and which is, in many respects, exactly like the interrupter in the Blake transmitter—he says (p. 62):—"I give to my instrument the name 'Telephon.'" Later on he says that the reproduction of human speech, which he has attained, is not so clear as to satisfy everybody, and that, though the consonants are transmitted distinctly enough, the vowels are not equally so, and he proceeds to discuss why this is the case.

2. *Brix's Zeitschrift des deutsch-oesterreichischen Telegraphen Vereins*, 1862, Vol. IX., p. 125. This article is also reprinted in *Dingler's Polytechnisches Journal*, 1863. Bd. CLXIX., p. 23.

This is a report by Inspector von Legat on Reis' Telephone in its developed form. Inspector von Legat says that this instrument was able to reproduce single words uttered, as in reading and speaking, though not so distinctly as it reproduced chords and melodies. which latter it transmitted with marvelous fidelity. He even added that the inflexions of the voice, the modulations of interrogation, exclamation, wonder, and command attained distinct expression!

So much for Bell's references; Edison's reference is the same as No. 2 of the preceding.

As to the publicity of these documents, permit me to refer you to the shelves of the British museum and other public libraries.

I do not say that there is not plenty of further evidence, were such needed. But here I am quite content to accept the references given by such unimpeachable authorities as Bell and Edison. When they refer me to papers wherein Reis says in substance: "I am the inventor of the telephone. My instrument is intended to transmit human speech and all other kinds of sounds that a human ear can hear, and it succeeds in doing so, though I find, to my disappointment, that it is not yet quite perfect, because, though single words and consonants come through all right, the vowels are not clear." I am bound to believe, on the authority of Bell and Edison, who give me these references, that Reis's modest claim is just. And I am bound to this belief still more strongly because I find, when I make careful trial of Reis's own telephones, that they will do exactly what he said they were intended to do—namely, transmit human speech to a distance by the agency of the galvanic current.

You have, Mr. Editor, most aptly said that the question is, what was *the kind of success aimed at* and attained by Philipp Reis? and I entirely agree with you, that this question is not, in the least degree, affected by whether Philipp Reis is dead or alive. Though himself be dead, and the task of defending his memory from outrage falls to others, his words still live to testify, in the most unmistakable manner, to the aim which he set before himself, and to the measure of success which he attained in his invention of the telephone. Yours, etc., SILVANUS P. THOMPSON.

BRISTOL, March 4, 1883.

P.S.—There is a slight *erratum* in line 12, from bottom of p. 373, where, by mischance, the word which I wrote has been altered from *perfected* to *perfect*. Philipp Reis's telephones of 1862 were not perfect, but were perfected instruments compared with those he showed to the Physical Society in 1861.

THE PROGRESS OF TELEGRAPHY.

ON February 15th, at the Institution of Civil Engineers, Mr. W. H. Preece, F. R. S., delivered a lecture on the above subject, the following abstract of which appears in the London papers:

Telegraphy is the oldest practical application of electricity. It grew about the railway system, and was rendered a practical agent by the foresight of Robert Stephenson, I. K. Brunel, Joseph Locke, and G. P. Bidder, who were its godfathers in England. Electric currents are, as a rule, maintained for telegraphic purposes, by the combustion of zinc; and, in the innumerable forms of batteries in use, the conversion of zinc into sulphate of zinc, is the root of the transformation of energy into that form which was utilized as electric currents. There are three forms of battery in use in the British post office telegraph system, and in the following numbers:

Daniell	87,221 cells.
Leclanché	56,420 "
Bi-chromate	21,846 "

Every administration has its own adopted form, differing in design, but based on one or other of these types. Magneto-electricity is employed for some forms of apparatus, and dynamo machines are sometimes used to supplement batteries. Experiments are now being made with secondary batteries. The various terms employed—electro-motive force, resistance, induction, and current—though measurable in definite units, have not yet become household words; but, being admitted into commercial, legal, and parliamentary lore, they will soon be as familiar as feet, gallons, or pounds.

Electric currents are conveyed from place to place, either overground, underground, or submarine.

OVERGROUND.

Wooden poles, preserved in creosote, are employed in England, but iron poles are extensively used in the colonies. The conducting wire is almost universally of iron, but copper wire is much used through smoky places, where iron is liable to rapid decay. Phosphor-bronze wire is under trial, and is a very promising material, as it possesses the conductivity of copper, with the strength of iron. The improvements made in the quality of iron wire have been very great, and it conducts now fully 50 per cent. better than it did a few years ago. Electric tests have had a marvelous effect upon the production of pure metallic conductors; copper has improved in even greater ratio than iron; samples have been produced, better even than the standard of purity. The insulators remain principally of porcelain, and their forms vary nearly with the number of individuals who use them; the only improvement of any value recently made, is one which facilitates the very necessary process of cleaning.

UNDERGROUND.

Wires are almost invariably carried underground through towns. Copper wire, insulated with gutta-percha, incased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the post office system underground, would mean an expenditure

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of about £20,000,000. Hence there is no desire to put wires underground, except in towns. Besides, snowstorms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been used for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

SUBMARINE.

The past ten years has seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty, even in the deepest oceans. Thanks to such expeditions as that of H. M. S. *Challenger*, the floor of the ocean is becoming more familiar than the surface of many continents. There are, at present, 80,000 miles of cable at work, and £30,000,000 have been embarked in their establishment. A fleet of twenty-nine ships is employed in laying, watching and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable used has been but very little varied from that first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached 90 tons to the square inch, and the machinery for laying, have received such great advances, that the last cable laid across the Atlantic, by the Telegraph Construction and Maintenance Company, was done in twelve days, without a hitch or stoppage.

Ideas are conveyed to the mind by electric signals, and in telegraphy these signals are produced at distant places, by using two simple electrical effects: 1, that a magnetic needle tends to place itself at right angles to a wire, when an electric current passes through it; and 2, that a piece of iron becomes a magnet when a current of electricity circulates around it. An innumerable quantity of tunes can be played on these two strings. Various companies were established at different times to work certain systems, but when the telegraphs were absorbed by the State, the fittest were selected to survive, and their number consequently declined.

The A B C instrument is the simplest to read, for it indicates the letters of the alphabet by causing a pointer to dwell opposite the desired letter. There are 4,398 in use. Its mechanism is, however, complicated and expensive, and it is being rapidly supplanted by the telephone. The needle instrument is the simplest in construction, but it requires training to work it. There are 3,791 in use in the post office, and 15,702 among different railway companies. As a railway instrument, it is the simplest, cheapest, and most efficient ever devised. The Morse instrument, of which there are 1,330 in use in the post office, and 40,000 on the Continent, records its letters in ink, in dots and dashes on paper tape, and, like the needle and A B C, appeals to the consciousness through the eye; it also indicates the letters of the alphabet by sound, and thus utilizes the organ of hearing. Sound reading is gaining ground in England with great rapidity. There are now 2,000 sounders in use; in 1869 there were none. In America, scarcely any other instrument is used. On the Continent there is scarcely one.

Acoustic reading attains great perfection in Bright's bell instrument, where beats of different sound replace the dot and dash of the Morse alphabet. Sound reading is more rapid and more accurate than any system of visual signals or permanent record. In fact, no record is kept in England, for the paper tape is now destroyed as soon as it has been read. Errors are, of course, inherent in all systems of telegraphy. A telegraphist cannot see what he writes, or hear what he says, and who is there that does not make mistakes whose eye follows his pen, or whose ear takes in his own words? The Hughes' type instrument, which prints messages in bold Roman characters, is much used on the Continent; it is, in fact, recognized as the international instrument, but it has had to give way, in England, to a more rapid system of telegraphy. It is, however, solely used for the continental circuits, by the Submarine Telegraph Company. All long cables are worked by Sir William Thomson's beautiful siphon recorder.

In ordinary working, only one message can be sent in one direction at one time; but, by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilized to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and, by a still further improvement, where currents of different strength are utilized, four messages are sent on one wire—two simultaneously in opposite directions—at the same time. There are, in England, 319 duplex, and 13 quadruplex circuits at work.

The acme of efficiency in telegraphy is attained in the automatic system, in which manual labor is supplanted by mechanism, in transmitting the messages. There are 71 circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute. is easily maintained upon them. When the hand alone is used, from 30 to 40 words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high speed repeaters, the length of circuit for automatic working is scarcely limited; it would be easy to send 100 words per minute to India.

The growth of business since the telegraphs have been acquired by the State is enormous; 126,000 messages per week have grown to an average of 603,000; but the mileage of wire has not increased in anything like the same proportion, the excess of traffic having been provided for by the great improvements made in the working capacity of the apparatus. In 1873, the average number of messages per mile of wire was 147, it is now 256. It is in press work that the greatest increase has taken place; 5000 words per day at the time of the companies have grown to 934,154 words per day now. 340,966,344 words of press matter were delivered in the year ending March 31, 1882.

The development of railways has necessitated a corresponding increase in the telegraphs required to insure the safety of the traveling public, and while 27,000 miles of wire in England, Scotland, and Wales were used for that purpose in 1869, at the end of December, 1882, the total had increased to 69,000 miles, equipped with 43,176 instruments, against 8,678 in 1869,

The growth of business is equally discernible in the great cable companies. In 1871, the number of messages dealt with by the Eastern Telegraph Company was 186,000; in 1881, it was 720,000. This growth is equally striking in all civilized countries, and even in Japan 2,223,214 messages were despatched last year, of which 98 per cent. were in the native tongue. The mode of transacting the trade of the world has been revolutionized; and while wars have been rendered less possible, their conduct has been expedited, and their penalties alleviated.

—— A WASHINGTON DESPATCH says: Interesting and important developments are expected as the result of the pending cross-examination of Prof. Alexander Graham Bell, in the case of the People's Telephone Company and the American Bell Telephone Company. This particular suit was brought in 1880, and the expectation is, that it will be argued before Judge Wallace, of the United States District Court for the Southern District of New York, during the coming autumn. The American Bell Telephone Company is represented by its counsel, Mr. J. J. Storrow, of Boston. The People's Telephone Company is represented by Lysander Hill, of Chicago, with Park Benjamin, of New York, as expert counsel. Prof. Bell was examined in this case a year or two ago, but never cross-examined. The cross-examination was delayed by one cause and another, until this winter. When the time came for cross-examination, Prof. Bell was not able, on account of the illness of a child, to leave Washington, so the lawyers came here. One of the parlors in Prof. Bell's handsome new house, has been transformed into a temporary court room. There the counsel meet, almost every day and night, and propound the questions they have prepared. The cross-examination is expected to end soon. The points the counsel for defendant are trying to establish they, of course, decline to make public. But, as a matter of public interest, they say, this is the first time that any examination was ever held which would have the effect of bringing out all the details of the invention of the telephone. Prof. Bell is simply telling, in response to these cross-interrogatories, the story of his invention. The People's Company, it will be remembered, claims that Daniel Drawbaugh, of Harrisburg, Pa., is the original inventor of the telephone, and that it can prove by scores of witnesses, that he operated a telephone, embodying all the principles of the Bell telephone, six years before Bell applied for a patent.

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THE ELECTRICIAN.

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WE call attention, in another column, to the first of a series of articles on "Steam Engines for Electric Lighting Plant," from the pen of Professor Robert H. Thurston, of Stevens's Institute of Technology. Professor Thurston's experience in the construction and management of engines and machinery, his reputation as a student of mechanical science, and the fact that his subject is, at present, engaging the attention of scientists here and abroad, and that the development of the steam engine is, to a certain extent, that of the world's progress, will cause general interest in his writings; and they will, doubtless, be read with avidity by the fellow members of the leading scientific societies to which he belongs, among which are the American Society of Mechanical Engineers, of which he was president, the American Institute of Mining Engineers, the Institution of Engineers and Ship Builders of Scotland, the British Institution of Naval Architects, and the Academy of Science.

THE PROSPECTS OF ELECTRIC LIGHTING.

RAPID transportation, in shortening unavailable time, and artificial light in lengthening available time, minister to the necessities of commercial and home life; and, very naturally, form our greatest industries. Twenty per cent. of the business capital in the United States is invested in railways, and the next leading industry is the production of artificial light; and, although we are not aware of any comprehensive statistics on the subject, we think it may be roughly estimated at something more than one per cent. of the business capital.

When one considers the immense resources of the corporations manufacturing gas, and of the petroleum refining interests, and also the great length of time and enormous outlay which have been necessary for bringing gas lighting and lighting by oil to their present state of convenience and efficiency, it is surprising how rapid have been the advances of the electric light.

The problem of the future of electric lighting involves many interests. Enough capital has been invested in this enterprise, to render its stability a matter of importance to the financial world; while those who have invested in electric lighting await the ultimate result of their undertaking. The public recognizing the general advantages of the new system of illumination, awaits with impatience its perfection and general introduction. To some inventors, heart-weary with hope deferred, the success of some particular system represents the height of human ambition; and the young man about to choose a vocation, has to consider whether the promise of the ultimate growth of electric lighting offers to him that opportunity which, "If taken at the flood, leads on to fortune."

Only four or five years have elapsed since the first commercial introduction of the arc light in this country, and hardly two years since the incandescent light was first brought before us in practical form.

At the present time, the electric light repels the gloom of night in every important city of the Union. The experience of its use in mills has demonstrated its superiority for such use to other methods of illumination, both in respect to economy, and in respect to the absence of excessive heat, and deleterious products of combustion which enervate the employees; and the advantages from this cause, and the more thorough illumination attainable, add to quantity and quality of the manufactured product. In stores, the value of the electric light in exhibiting goods at their best advantage would warrant its use, even if other considerations were disregarded. Wherever a better, purer, and stronger light was desired, there, electricity has been able to fill the demand.

This has been accomplished in the face of enormous difficulties. When the commercial manufacture of electric lighting apparatus commenced, it was a business without precedents; everything being new, crude, and undeveloped. No trained assistants were available; the books on electricity contained nothing upon the modern use of heavy electric currents; the scientific schools taught little of value; telegraphy had little in common with the subject, beyond a few general principles, so that neither technical graduates, nor telegraphers, were prepared to enter upon electric lighting work without further training. Mechanics had much to learn in matters of construction of apparatus; the proper manufacturing supplies were not in the market; and even engines, most suitable for driving dynamo machines, had to be invented. The development of the whole business, from the least unto the greatest, required invention, education, and organization.

The general business of electric lighting has not been without errors. A mistake, which is deplored by all who have any interest in the prosperity of electric lighting, has been the undue extent to which the business has been involved in speculation upon fictitious valuations of patents. Instead of firms, or corporations, wherein the inventor and the capitalist could place the joint product of their brains—mechanism and money—upon an equitable basis, the speculator has come in with pernicious schemes of amplified capital stock.

"You may put me down for one of the ciphers, and then there will remain only five hundred dollars to raise," said the late Isaac O. Barnes, to the elder who bore a subscription paper for the purpose of raising $5,000 to pay off the debt of the Mount Zion (colored) Church. "Dis yer firgurins all 'krect, but whar's the dollars?" said the elder, after an interval. In numerous instances of electric light enterprises, so many have *subscribed to the ciphers*, that comparatively few dollars have been left for the prosecution of the business. In England, this matter has been carried to a ruinous extent, where capitalization has been forced to a point far beyond that justified by any judicious estimate of the prospects for business.

The first effect of the introduction of the electric light upon the gas companies was civility, and the second, prosperity.

The brilliant illumination produced by electricity, has quickened the demand for more light, and consumption of gas has been increased wherever electric lights have been used.

When electric lights were first introduced in the streets of New York, much fear of the new rival was expressed at

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the directors' meeting of a gas company. One of the heaviest stockholders said, that as long as electricity remained in the street and did not enter the houses, their resistance must be very passive ; and facts were presented showing, that when a certain street was lighted with electricity, a neighboring hotel, unwilling that its gas lights should appear so dim, removed its gas regulator, and thereby increased its consumption of gas about twenty per cent.

It has been claimed that electricity will supersede gas; but no extension of a perfect light would accomplish such a result immediately, or without a hard struggle.

It is no disparagement to electricity to state, that the electric light has not caused the removal of a single gas meter, if it can also be proven that it has created an increased demand for illumination sufficiently great to warrant the introduction of electric lighting. It is well-known, that the consumption of gas has increased wherever electric lights have been used. The presence of the more powerful light produces a demand for better illumination elsewhere.

It is not considered that the use of kerosene has entailed any severe hardship upon the gas companies, because kerosene is used where gas is out of the question, and very rarely because it is cheaper. Because the field for electric lighting is very large, it is not boundless. The limits cannot be stated at the present time, but they will be as well defined as those between gas and kerosene. As more is learned by experience concerning the details of its application, dangers will be obviated, prejudices will be overcome, and the uses of the electric light will be multiplied. When the Houses of Parliament, in London, were built, the architect's specifications required that no wood-work should approach within six inches of the gas pipes.

Lighting is but one of the purposes for which electric currents are available. Electricity is energy, and the light is merely the result of the conversion of this energy into heat. Electrical energy is also convertible into mechanical work ; and whenever any satisfactory electric-motor fitted for a wide range of duties, is introduced to the public, then there will be a demand for electricity for domestic uses, in addition to the numerous minor industries which require small powers.

If the motor was at hand, it would be used for pumping water, running sewing machines, dumb waiters, ventilating apparatus, and many domestic purposes for which there is now no motor, and really little demand.

The introduction of such improvements, require time for the general public to be educated to the appreciation of the convenience of such a convenient and safe motor in the house.

Some persons are in expectation of improvements in electric light apparatus, which will diminish the power required one-half, or some equally impossible reduction. There is not room for much economy in this direction. The dynamo machine approaches more nearly to theoretical perfection than any other machine known to mechanics.

The most serious obstacle to the economical generation of electricity by dynamo machines, is the extremely low efficiency of the steam engine as a means of converting heat into mechanical work.

We may commiserate the poor native, in the interior of Africa, who traps an elephant, starves the brute, and carries his tusks to the next tribe, where it is passed along in turn to the seaboard. Once sold for the quota of rum, beads and calico, the last messenger drinks the rum for his services, and passes the beads and calico to the man who gave him the tusks, and each one appropriates a share for his work, until the poor fellow who obtained the tusks, finally receives hardly enough cloth to remind him of the sin of Eden, and a necklace of beads for his favorite wife.

Yet we make a similar transaction in the operation of every steam engine and boiler. A steam engine supplied with steam from a boiler which evaporates eight pounds of water for every pound of coal consumed, and requires three or four pounds of coal per horse power per hour, represents the operation of a well arranged boiler and non-condensing steam engine. The combustion of each pound of fuel produces a chemical change, which develops a certain amount of heat; but the boiler and its setting levy a toll of about thirty per cent. of this amount, for services in generating the steam. The steam passes to the engine cylinder, but the services of only a part of the steam are accepted and converted into work, the rest being used to warm the cylinder, or blown out of the exhaust as contemptuously as salt without savor. But the work is in the cylinder of the engine, and is not available for use, and allowance still has to be made for friction and other losses.

After making proper deductions for all these losses, probably not more than ten per cent of the theoretical energy of the fuel is finally available for driving the dynamo. It has been stated by mechanical engineers of the highest authority, that the best compound condensing engines of very large size do not show a higher efficiency than from fifteen to eighteen per cent.

Evidently, if some method could be devised for generating electricity from heat directly, which would avoid any considerable part of this enormous waste of energy, a great advance would be made, which would give electric lighting possession of almost the entire field of artificial illumination, and make the electric motor a formidable competitor of the steam engine, as a prime mover, wherever mechanical power is used. It is possible that a discovery may be made which will realize this, but we see no indications which point to the direction from which it may be expected. Experiments with the thermo-pile have not proved encouraging, and although other forms of generator have been suggested, none of them seem to promise practical results immediately.

In the meantime we must rest content with the dynamo machine, and use the best mechanical power attainable for driving it.

But, while we may not look for any great improvement of present dynamos in the direction of greater economy of power, we may reasonably expect considerable simplification of construction and reduction of cost. Other parts of the apparatus will also undoubtedly be greatly improved in efficiency, and their cost will be reduced and many accessories and minor appliances will be added to existing systems, from time to time, which will greatly increase their efficiency, safety, and convenience in general use.

The extension of the central station system will undoubtedly constitute the great future of electric lighting. In this we may reasonably expect very great reduction in operating expenses, from the adoption of improved apparatus and better systems of distribution and regulation, the employment of cheaper labor in construction and attendance, and from greater experience in the details of management.

With the reduction of cost will come increased demand and a larger extension of the business.

As it stands to-day on the work it is doing, and its proven capabilities, electric lighting rests on a prosperous basis, with brilliant prospects for the future.

— THE LATEST THEORIES concerning the sun, consider that it gives forth energy, which appears as heat, light, or electricity, according to the medium which absorbs this energy. There are astronomical phenomena, especially those in connection with the divers directions taken by the tails of comets, which can be satisfactorily accounted for only on the hypothesis of electrical action, which is supposed to pervade the inter-planetary spaces. The electricity in the sun is of opposite polarity to that of space.

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STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY PROFESSOR ROBERT H. THURSTON

I.—HISTORICAL—THE DEVELOPMENT OF THE STEAM ENGINE.

THE growth of the steam engine into the forms now familiar to everyone who takes the slightest interest in this most important of modern mechanisms, has occurred by a series of transitions which is easily traced, and which is especially interesting to every thoughtful mechanic as representing the steps in a steady progression, toward ideal perfection, of which the end is not yet seen.

A century ago, James Watt had just begun to introduce the first engines belonging to a, then, new type.[1] A century before (1698), the ingenuity and practical skill of Captain Savery, had conferred an enormous benefit upon the mining industries, and through them upon the world, by applying the "fire engine" of the Marquis of Worcester to raising water from the then rapidly deepening mines.[2] Savery used steam of 8 to 10 atmospheres (120 to 150 pounds) total pressure, in some cases, and he is entitled to fame as the first to introduce that now familiar concomitant of civilization, the steam boiler explosion. The usual pressure was 3 atmospheres. These engines demanded about 30 pounds of coal, per horse-power per hour, as a minimum. The apparatus of Savery was not what would to-day be called a steam engine, at all. It was not a train of mechanism, involving moving parts, cylinder, piston, crank and fly-wheel, but either a single pair of closed vessels, or three vessels, one of which was a boiler, and the other, or others, metal chambers of spherical, cylindrical, or ellipsoidal form, which were at once condensers and pumps. The latter were filled with steam, which being condensed, the water rose into, and filled them, and was then forced out by a succeeding charge of steam, of pressure exceeding that of the head against which the lift took place. Huyghens (1680), and Papin (1690), proposed true engines with steam pistons traversing their cylinders, and forming, on the whole, much such a train of mechanism as is now so well known[3]; but the Newcomen engine was the first of this type to come into practical use. This machine, then called the "Atmospheric Steam Engine," consisted of a steam cylinder, with a piston taking steam beneath, the upper end of the cylinder being open to the atmosphere, the piston actuating a "working beam," or "walking beam," and, through the latter, working pumps attached to the opposite end. Neither crank, shaft, nor fly-wheel was used; the action of the engine was controlled entirely by the adjustment of its valves. In its operation, steam at a little higher than atmospheric pressure, was admitted below the piston; the weight at the pump end depressed that extremity of the beam, raising the piston. The steam below the piston was then condensed by a jet of water thrown into the cylinder, producing a vacuum; and atmospheric pressure, finally forced the piston down, raising the pump-rod and plungers. The weight on the latter was adjusted to the work, so that, when steam was admitted, this weight should force the pumps to discharge the water. The only function of the steam was the displacement of the atmosphere, or counter balancing it, by entering below the piston, and thus permitting the formation of a vacuum. A writer of that time states[4] that "Mr. Newcomen's invention of the fire engine, enabled us to sink our mines to twice the depth we could formerly do, by any other machinery"; but "every fire engine of magnitude consumes £3,000 worth of coal per annum." The coal consumption was, at best, about 20 pounds per hour and per horse-power. Smeaton, the greatest civil engineer of his time, put up many of these engines in Holland and elsewhere, as well as in Great Britain; some were 66 inches in diameter of cylinder, and 8 to 9 feet stroke of piston. It was this engine that Watt found in operation, when he entered upon the stage.

Watt was not simply a mechanic; he was a real philosopher, and a truly scientific investigator. A model Newcomen engine, having been brought to him to be repaired, he took advantage of the opportunity to study the principles of its construction, to ascertain its defects, and to devise proper remedies. He found that the sources of loss were the conductivity, and radiating power of the steam cylinder, the alternate heating and cooling of the metal at each stroke, the imperfect vacuum, and the wastes from boiler and steam pipes. To correct these defects, he clothed his boilers and steam pipes with non-conductors, sometimes, even making boiler shells of wood. Smeaton had already covered the pistons and cylinder heads with wood. Watt made a small wooden steam cylinder, and obtained great economy; he made a more practicable improvement, however, when he devised the steam jacket. He attached a separate condenser to prevent the loss due to the introduction of condensing water into the steam cylinder, closed the cylinder at the top, made the engine double-acting, and finally, adapted the engine drive machinery, fitting it with shaft and fly-wheel, throttle valve, and governor, and thus making the steam engine such as we see it to-day, in all essential particulars, not excepting the steam jacket, and the arrangement, of its valve gear to secure economy by the expansion of the steam. His engine was substantially complete by the year 1784.[5]

Later changes have been a succession of refinements, and of developments in application. Stephenson, and his contemporaries, applied steam on railroads; Stevens, Fitch, and Evans, and, finally, Fulton, in the United States, and Bell and others, in Europe, introduced steam navigation; Sickels invented the "detachable" cut-off valve gear; Corliss introduced the peculiar type of engine that has given him a world-wide fame, and so attached its governor as to determine the point of cut-off automatically, and thus to regulate the engine; and, a little earlier, Robert L. and Francis B. Stevens designed the American river steamboat, and its beam engine, with so simple and effective a valve gear that it remains, to-day, still standard. The compound engine, even, was brought out by contemporaries of Watt, and thus every prominent feature and essential detail of the modern steam engine was introduced at, or before, the beginning of the nineteenth century.

Yet, practice has been steadily changing during the century, and the form and proportions of the steam engine, and the methods of steam distribution, have been undergoing constant changes. In the time of Watt, steam was worked at about 7 pounds pressure, per square inch, in stationary engines; they were always fitted with condenser and air-pump, and were slow in movement, and were, consequently, of small power in proportion to their size; they wasted heat and fuel to such an extent, as to demand 6 or 8 pounds of coal per horse-power and per hour. It is true that Wolff, in 1804, expanded 6 or 8 times, using higher steam and obtained the horse-power with 4 pounds of fuel per hour, and that John Stevens and Oliver Evans, in the United States, and Trevithick, in Great Britain, had already used still higher steam in non-condensing engines; but these examples simply illustrated the fact, now familiar to every student of philosophical history, as pictured by Draper, Buckle and

1. History of the Growth of the Steam Engine. International Series. N. Y., D. Appleton & Co.

2. The writer finds this engine described in Harris's "*Lexicon Technicum*," of 1704, of which, now rare work, he is so fortunate as to possess a copy.

3. Mem. Acad. Sci. Paris, 1680. Acta Eruditorum. Leipsic, 1690.

4. *Mineralogia Cornubiensis*. Price. 1778. Appendix.

5. History of the Growth of the Steam Engine. P. 119.

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Leckey, that isolated examples which lead standard practice by a half century or more, are to be observed during the growth of every art. Recognized standard practice is always as conservative as it is permitted to be by trade competition, and usually changes very slowly. Principles may be discovered and understood, and a correct theory of design and of practice may be made generally familiar, and often is, in a brief period; but the growth of application and the familiarizing of constructors and operatives with new mechanisms, and new methods of management, requires time, and is slow at best. Thus it has happened, that although the principles of steam engine economy were, in the main, well understood by James Watt, and some of his competitors, nearly a century ago, and have become well settled in later years, we are still far from a completely satisfactory solution of the problem, which, as stated by the writer elsewhere* may be enunciated thus:—"To construct a machine which shall, in the most perfect manner possible, convert the energy of heat into mechanical power, the heat being derived from the combustion of fuel, and steam being the receiver and conveyer of that heat."

EQUIVALENTS OF ELECTRICAL AND MECHANICAL ENERGY.

AS electricity is now produced in such large quantities by mechanical powers, it is often required to calculate the amount of electricity which corresponds to a given power; or, in the case of electrical motors, the amount of power which corresponds to a given electric current. To facilitate such calculations, the following tables were calculated. They give the values of the electrical units of energy, in terms of all the mechanical units of energy used in this country, England, France, and Germany; and the values of all these mechanical units, in terms of the electrical units.

Before proceeding to explain the tables and the basis on which they are calculated, it may be well to call attention to a distinction, between the two forms of expressing mechanical energy, *work* and *power*. *Work* depends on the weight lifted, and the distance through which it is lifted, or, in more general terms, the force acting, and the distance through which it acts; it is, therefore, independent of *time*. *Power* is work done in a certain time; and, therefore, depends on time, as well as weight and distance. To express this in a formula—

$$\text{power} \times \text{time} = \text{work}$$

therefore

$$\frac{\text{work}}{\text{time}} = \text{power}.$$

For instance—

2 horse-power for 10 minutes = 660,000 ft. lbs.

$$\frac{\text{660,000 ft. lbs.}}{\text{10 min.}} = \text{2 horse-power.}$$

Heat, being only another form of work, is included in the general term *work*.

The units, in terms of which an electrical current, or electrical energy, is given, are—

Ampére—the unit of current strength—generally represented by *C*.

Volt—the unit of electro-motive force—generally represented by *E*.

Ohm—the unit of resistance—generally represented by *R*.

Coulomb—the unit of quantity—generally represented by *Q*.

* Ibid. P. 466.

In order to calculate these tables, it was necessary to have some one equivalent between an electrical unit of energy, and a mechanical unit of energy, all the others being readily calculated from this one. This equivalent was calculated in the following way. As two quantities of like electricity repel each other, work is done by moving a quantity of electricity toward another quantity, against the repelling force; that is, moving it through a difference of potential, or against an electro-motive force. If the electro-motive force moves the electricity, work is done by the current. Therefore—

work = electro-motive force x quantity;

or, using W to express the work of the current—

$$W = E\,Q.$$

As mechanical work is generally given in foot-pounds or in kilogrammetres, E in volts, and Q in coulombs, it is necessary, in order to get some numerical relations between them, to reduce them all to the same units. This can readily be done by the *C. G. S.* system of units. In this system:

1 absolute unit of work = 1 absolute unit of electro-motive force x 1 absolute unit of quantity. (1)

1 absolute unit of work = 1 erg. (2)

1 volt = 10^8 absolute units of electro-motive force.

1 coulomb = $\frac{1}{10}$ absolute unit of quantity.

Therefore—

1 absolute unit of electro-motive force = $\frac{\text{1 volt}}{10^8}$ (3)

1 absolute unit of quantity = $\frac{\text{1 coulomb}}{\frac{1}{10}}$ = 10 coulombs. (4)

Substituting the values from (2), (3), and (4), in equation (1)

$$\text{1 erg} = \frac{\text{1 volt}}{10^8} \times \text{10 coulombs.}$$

From which

1 volt-coulomb = 10^7 ergs. (5)

An erg is the amount of work done by a force of 1 dyne, acting through 1 centimetre, that is—

1 erg = 1 dyne x 1 centimetre.

A gram is = g dynes (g = acceleration of gravity).

therefore, $$\text{1 dyne} = \frac{\text{1 gram}}{g}$$

and $$\text{1 erg} = \frac{\text{1 gram}}{g} \times \text{1 centimetre.}$$

Substituting this value in (5),

$$\text{1 volt-coulomb} = \frac{10^7}{g} \text{ gram centimetre.}$$

Taking the mean value of $g = 981$,

1 volt-coulomb = 10193.679 centimetre grams.

As centimetre grams are readily reduced to foot-pounds, heat-units, horse-powers, etc., this equation is the basis on which the tables were calculated.

As almost all the equivalents are incommensurable, it would be troublesome to divide them into a number; for this reason, the reciprocals of all these numbers have been calculated; so that all calculations can be made by a single multiplication. As a volt-coulomb is a volt-ampére per second, the two are interchangeable, the one representing work, the other (volt-ampére) power. When the electro-motive force in volts and the current strength in ampéres is given, the power of the current in volt-ampéres is of course equal to their product. But when the current strength and the resistance of the circuit are given, the power in volt-ampéres is C^2R, in which C is the current strength in ampéres, and R the resistance of the circuit in ohms. Similarly, if the resistance and the electro-motive force are given, the power in volt-ampéres, is $\frac{E^2}{R}$, in which E is the electro-motive

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force in volts, and *R*, the resistance in ohms.

These tables give the *actual* equivalents, and, therefore, do not take into account the loss in converting one kind of energy into another, as that is dependent upon the particular machine used.

EQUIVALENTS OF WORK.

				Logarithm.
1 volt-coulomb =	1.0000000	volt-ampére per second		0.0000000
	.737324	foot-pounds		$\bar{1}$.8676580
	.101937	kilogrammetres		$\bar{1}$.0083310
	.00095508	pound-Fahr. unit of heat		$\bar{3}$.9800407
	.00053060	pound-centigrade "		$\bar{4}$.7247682
	.00024067	kilogr.-centigrade "		$\bar{4}$.3814342
	.00134059	horse-power per second		$\bar{3}$.1272954
	.000022343	" per minute		$\bar{5}$.3491441
	.00135916	force-de-cheval* per sec.		$\bar{3}$.1332698
	.0000226526	" per min.		$\bar{5}$.3551185
1 volt-ampére per sec. =	1.0000000	volt-coulomb		0.0000000
1 foot-pound =	1.35626	volt-coulombs		.1323420
1 kilogrammetre =	9.810000	"		.9916690
1 pound-Fahr. unit of heat =	1047.030	"		3.0199593
1 pound-centigrade " =	1884 655	"		3.2752318
1 kilogr.-centigrade " =	4154.950	"		3 6185658
1 horse-power per second =	745.941	"		2.8727046
" per minute =	44756.47	"		4.6508559
1 force-de-cheval* per sec. =	735.750	"		2.8667302
" per min. =	44145.00	"		4 6448815

EQUIVALENTS OF POWER.

				Logarithm.
1 volt-ampére =	1.00000	volt-coulomb per second		0.0000000
	.00134059	horse-power		$\bar{3}$.1272954
	.00135916	force-de-cheval*		$\bar{3}$.1332698
	.737324	foot-pounds per second		$\bar{1}$.8676580
	44 23944	" per minute		1.6458093
	2654.3664	" per hour		3 4239606
	.101937	kilogrammetres per sec.		$\bar{1}$.0083310
	6.11622	" per min.		.7864823
	366 9732	" per hour		2.5646336
	.00095508	pound-Fahr units of heat	per sec.	$\bar{3}$ 9800407
	.0573048	"	per min.	$\bar{2}$.7581920
	3 438288	"	per hour	.5363433
	.00053060	pound-centigrade units of heat	per sec.	$\bar{4}$.7247682
	.0318360	"	per min.	$\bar{2}$.5029195
	1.910160	"	per hour	.2810708
	.000240670	kilogram-centigrade units of heat	per sec.	$\bar{4}$.3814342
	.0144402	"	per min.	$\bar{2}$.1595855
	.866412	"	per hour	$\bar{1}$.9377368
1 volt-coulomb per sec. =	1.000000	volt-ampére		0.0000000
1 horse-power =	745.941	volt-ampéres		2.8727046
1 force-de-cheval* =	735.750	"		2.8667302
1 foot-pound per sec. =	1.35626	"		.1323420
" per min. =	.0226043	"		$\bar{2}$.3541907
" per hour =	.0003767380	"		$\bar{4}$ 5760394
1 kilogrammetre per sec. =	9.8100000	"		.9916690
" per min. =	.163500	"		$\bar{1}$.2135177
" per hour =	.00272500	"		$\bar{3}$.4353664
1 pound-Fahrenheit unit of heat per sec. =	1047.030	"		3 0199593
" per min. =	17.4505	"		1.2418080
" per hour =	.290842	"		$\bar{1}$.4636567
1 pound-centigrade unit of heat per sec. =	1884.655	"		3.2752318
" per min. =	31.41091	"		1.4970805
" per hour =	.523515	"		$\bar{1}$.7189292
1 kilogram-centigrade unit of heat per sec. =	4154.950	"		3.6185658
" per min. =	69.2492	"		1.8404145
" per hour =	1.154153	"		.0622632

The following examples will illustrate the use of the foregoing tables.

I. How many incandescent lamps, requiring an electro-motive force of 60 volts and a current of 1.5 ampéres each, can be supplied by an engine giving 15 useful h. p.?

*1 force-de cheval or French horse-power = 75 kilogrammetres per second.

If the loss of energy in the dynamo is 20 per cent., then 80 per cent. of 15. = 12 will be the h. p. of current available. From the tables, 1 h. p. = 746 volt-ampéres; 1 lamp requires 1.5 x 60 = 90 volt-ampéres; therefore,

$$\frac{12 \times 746}{90} = 100 \text{ lamps very nearly.}$$

II. What h. p. is required to supply 100 lamps of 40 ohms resistance each, requiring an electro-motive force of 60 volts?

The number of volt-ampéres for each lamp is $\frac{E^2}{R} = \frac{60^2}{40}$

From the tables, 1 volt-ampére = .00134 h. p.; therefore,

$\frac{60^2}{40}$ x 100 x .00134 = 12 h. p. very nearly.

If the loss in the dynamo is 20 per cent., then 12 h. p. is 80 per cent. of the actual h. p. required; therefore,

$\frac{12}{.80}$ = 15 h. p.

C. O. HERING,
University of Penna.

PHILA., March 21st, 1883.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from Page 77.*)

THE UNIVERSAL STOCK PRINTER.

THIS instrument is one of the earlier inventions of Thomas A. Edison, and was produced by him for the Gold and Stock Telegraph Company, to perform the same functions on two wires, as the Calahan instrument performs on three wires. The peculiar device by which the saving of one wire is secured is called the "shifting type-wheel," by means of which either one of two type-wheels may be printed from at the will of the operator. Both of the type-wheels are controlled by one wire.

The construction of this instrument was also designed with a view to avoiding the faults of the earlier three-wire machine, as shown by the carefully kept records of complaints arising from the daily service of the large number of instruments which were soon put into actual use. Another great stride toward perfection in construction consisted of a feature, which was first applied to printing telegraph instruments by this inventor, viz.: the inter-changeability of the parts, which were made to gauge. Although this endeavor was not always rigidly carried out, on account of the expense and difficulty attending application of the principle to minor details, it was nevertheless adopted to a considerable extent. On account of its simplicity of design, electrically (it uses no principles that are not employed in the ordinary Morse sounder), as well as for economy in making installations, the instrument has always been a great favorite with the Company, for use in its branch systems in provincial cities. The fact that the Company had already made and introduced a large number of the three-wire instruments in this city before the universal instrument was invented, has prevented any extensive use of them in New York city, and there are now only about 100 of them in use here, principally on Petroleum and Mining Quotation circuits. Under the same electrical conditions, the speed of this machine is slightly faster than that of the three-wire machine, for which difference it is indebted to the more favorable form and arrangement of the escape-wheel and escapement anchor.

The form of transmitter originally designed for this machine, was never perfected by the inventor, who turned his attention to the subject of automatic telegraphy, before

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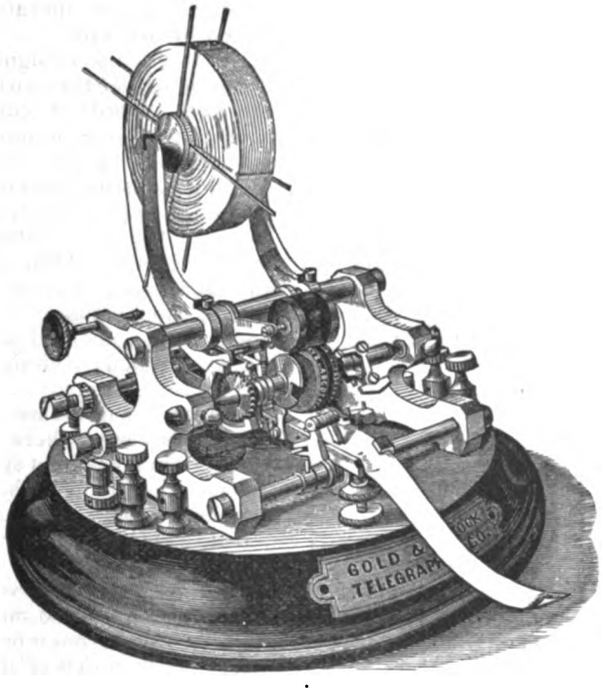
he had fully developed his ideas in the former field. The transmitting apparatus has, however, subsequently been much improved and perfected by Mr. George B. Scott, the Superintendent of the Company, and has now attained a high degree of reliability, with the great simplicity of construction. The receiving instrument is shown in full in Fig. 1, while Figs. 2 and 3 give details of the peculiar distinctive features of the machine.

The receiving instrument can be best described in four parts: *First*, the printing and feeding mechanism, operated by the press-wire; *Second*, the type-wheels and their accessories operated by the type-wire; *Third*, the unison device; *Fourth*, the shifting apparatus. The last two portions are operated by actions resulting from the operations of both wires combined.

The type-wheels are rigidly fixed, side by side, on a moveable sleeve or tube, Fig. 2, A, which may be slid lengthwise on the escape-wheel shaft, B. The type-wheel sleeve with the type-wheels attached, is, however, forced to revolve with the escape-wheel shaft when the latter rotates, by a guide pin C, projecting at right angles to the line of motion, and fastened to both type-wheels, and which passes through a slot in an arm D, which is rigidly fastened to the escape-wheel shaft by the screw E passing through a band or collar which encircles the shaft B.

An electro-magnet in the circuit of the type-wire, vibrates an armature carrying an anchor, which rotates a 15-toothed escape-wheel F, rigidly fixed on the escape-wheel shaft. The type-wheels each carry 30 characters, and 15 pulsations of the current, together with 15 actions of the retracting spring on the type armature, revolve the type-wheels once.

A single inking wheel, formed of discs of cloth laid side-by-side on a central shaft, and clamped together by end discs of ebonite, revolves on a spindle within a frame, which allows the inking wheel to rest on the type-wheels, and to revolve with them by friction.



Rigidly fastened on the same sleeve as the type-wheels, and a little to the left of the letter type-wheel, is a disc of the same diameter as the type-wheels, called the lock-wheel, (see G, Fig. 2). This disc has a notch in that portion of its periphery, which is in line with the space filled by both of the dots on the letter and figure type-wheels. These dots are not in line however, one being a character in advance of the other, in respect of a line drawn through both wheels at right angles to their plane of motion. The notch in the disc G, is as wide as the transverse space occupied by both of these dots, and when either of these two dots are opposite the paper, in a position to be printed from, the notch in the disc G, is opposite an upright arm with a wedge-shaped head (see G, Fig. 3), which projects upward from the press lever. The type-wheels may then be shifted transversely on the escape-wheel shaft; but in all other positions of the type-wheels, the wedge G, Fig 3, is in the path of any attempted lateral movement of the disc G, Fig. 2, and thus prevents any accidental movement of the type-wheels from the position they have been intentionally placed in by the operator; thus ensuring the rotation of the type-wheels in the same plane, at all parts of the revolution. For effecting printing from either of the two type-wheels at will, the type-wheel sleeve, A, Fig. 2, is provided with a pivoted T shaped lever H, having an arm I, extending at right angles therefrom, and fastened at its further extremity to the type-wheel sleeve. The T lever and arm have two pivots, one at J and one at K. Now, if the right-hand arm of the T piece H, be tilted upward, the type-wheel sleeve A, together with the type-wheels and slotted disc G, will be pushed to the left until the sleeve is stopped by the shoulder of the unison worm L, and the unison pin M.; provided the slot in the disc G is in a position to allow the wedge piece G,

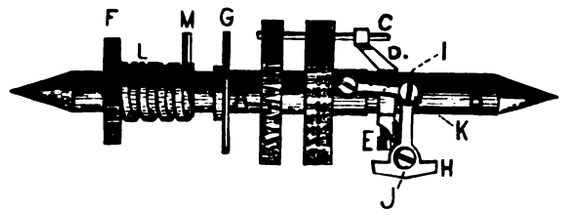
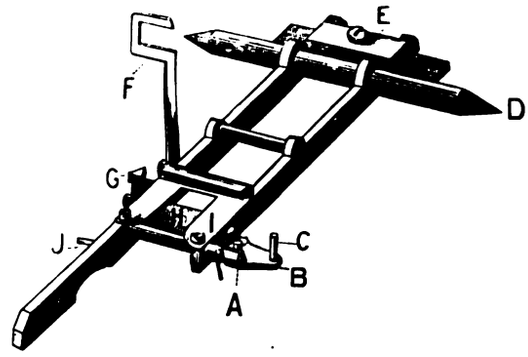


Fig. 3, to pass through. In this position the figure type-wheel will be vertically opposite the right hand margin of the band of paper, and the letter type-wheel will be immediately opposite the left hand rim of a thin flexible brass shield I, Fig. 3, which prevents the letter-types from touching the left hand margin of the paper.



On the other hand, if the left-hand arm of T piece H, be tilted upward, the type-wheel sleeve and its accessories will be carried to the right-hand, until stopped by the type-wheel sleeve touching the collar supporting guide-pin arm D. In this position the letter-types will be opposite the left-hand margin of the paper, and the figure-types will be above the right-hand rim of shield I, Fig. 3, which will prevent them from touching the paper.

The devices which enable the operator to shift the type-

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wheels are as follows: Fig. 3, shows the press-lever and its attachments. Two keys in the transmitter correspond in relative position to two dots, one on the letter type-wheel and one on the figure type-wheel, the latter being one tooth of the escape-wheel ahead of the former. The keys on the transmitter represent either letters or figures interchangeably, and there is but one bank of 30 keys for the 60 characters. When the first dot of the letter type-wheel, is brought opposite the paper with the slot in disc G, Fig. 2, opposite the wedge G, Fig. 3, and the letter dot key of the transmitter depressed, the press-lever comes up, bringing pin A, Fig. 3, on the plate B, of the press-lever, under the left-hand arm of the pivoted T lever H, Fig. 2. The type-wheels are pushed to the right as before described, and the letter-types are in position to be printed from indefinitely, since neither a continued rotation of the type-wheel, nor movements of the press-lever to take impressions therefrom, can move the type-wheels transversely. But if the operator desires to print from the figure type-wheel, he depresses the figure dot key, which stops the type-wheel with the figure dot opposite the shield and the slot in disc G, Fig. 2, opposite the wedge G, in Fig. 3. The upward movement of the press-lever brings the right-hand pin C, Fig. 3, under the right-hand arm of T lever H, Fig. 2, when the latter is tilted to the left and the type-wheels slid over to the left-hand with the figures opposite the paper, as before described.

In Fig. 3, D is the press-lever shaft and pivots, E the armature, F the unison-tripper, G the wedge piece, H the printing pad, I the flexible brass shield, and J the driving pin for the feeding mechanism.

The unison operates as follows: The free end of an arm, not shown in the diagram, rests in grooves between spiral threads cut on the escape-wheel shaft, see L, Fig. 2. This worm is provided with a unison stop pin M, Fig. 2, and upon continued rotation of the type-wheels, without printing, the free end of the arm resting in the grooves L, Fig. 2, will be carried to a position which will intercept a further onward movement of the stop pin upon the type-wheel shaft. This pin is so placed, that when it is locked by the unison arm the letter dot is opposite the paper, and pin A, Fig. 2, is opposite the left-hand arm of H, Fig. 2. This operation locks the type-wheels of all the instruments in unison. To release them and start them off together, the operator depresses the letter dot key, when the press-lever comes up and unison tripper F, Fig. 3, through the loop of which the unison arm passes, raises the latter from the unison pin M, Fig. 2, and a spiral spring pulls it to its original position in the groove between the two first threads of the unison worm, at the same time the type-wheels start to revolve.

The printing pad H, Fig. 3, is a small hollow cylinder of soft rubber, stretched over a cylinder of ebonite which revolves on a spindle, pivoted between the sides of the press-lever, as the paper is drawn over it. The paper feeding mechanism is very simple, and consists of two dogs or pawls, with sharpened serrated edges whose teeth point in the direction of motion of the paper. These pawls are always held down on the paper by spiral springs, and press the paper on a metallic barrel, which is free to revolve when motion is communicated to it. One of the dogs is slotted and pivoted on the pin J, Fig. 3, in the press-lever. An upward movement of the press-lever pushes this pawl forward, its sharp teeth catch the paper and drag it over the barrel. When the press-lever falls and the pawl starts on its backward path, the paper is clutched by the other pawl and thus the friction produced by the backward movement of the pushing pawl is prevented from dragging the paper backward. The transmitting apparatus for these machines will be described in our next.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

X, PART I—EARLY THEORIES OF ELECTRICITY.

ALTHOUGH, from the earliest period, the nature of electricity has been the object of much speculation, and since the time of Du Fay the probable occurrence of one or more kinds of electricity has been vigorously discussed, comparatively few of the persons who have interested themselves in the matter have ventured to advance even a hypothetical answer to the question,

"WHAT IS ELECTRICITY?"

Of the hypotheses suggested, the greater number originated during the earlier period of electrical history, and were founded upon a limited acquaintance with electrical phenomena; but, of them all, few are characterized by decided originality, fewer still are worthy of consideration as more than vague conjectures, and none, perhaps, are entirely accordant with the multitude of facts now known.

It may, however, be interesting, and in view of the influence they have exerted upon the progress of electrical science, perhaps important to review some of these suggestions, for they exercise the scientific use of the imagination, and represent the best efforts of the most able minds to grasp a problem the baffling complexity of which, modern scientific progress but enables us to realize, and contemplate, as the ancients did the phenomena of electricity, with wondering curiosity.

A problem thus impenetrable to modern science, Sir Francis Bacon, however, almost simultaneously with its first perception unhesitatingly disposed of as follows:[1] "Electricity (of which Gilbert[2] and others have devised such stories) is nothing else than the appetite of a body when excited by gentle friction, an appetite which does not well endure the air, but prefers some other tangible body if it be found near at hand."

Difficult as it would be to associate with others such an hypothesis, those which have appeared later may be roughly classified in order of dignity as follows:

Early.

- First, Supernatural. — Electricity a Soul or Spirit.
- Second, Effluvial.
  1. Emanation and Return Theory.
  2. Spherical Envelope Theory.
- Third, Fluid.
  1. Afflux and Efflux Theory.
  2. Agitated Envelope theory.
  3. One Fluid Theory.
  4. Two Fluid Theory.
- Fourth, Ethereal.
  1. An universally extended imponderable fluid more or less condensed around a material substance.
  2. The same condensed about the Molecules of a body.
- Fifth, Fire. — A universally extended imponderable fluid combining with Effluvia from the earth to form the atmosphere. The Ether, Electricity, and Fire one and the same.

1. Sir Francis Bacon. An Inquiry into Light and Luminosity. Works by Spedding, N. Y., 1856. Vol. 8, p. 88.

2. See first sketch.

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Modern. { Sixth, Mode of Motion. { 1 All forces, modes of motion of Ethereal or Material Masses or Molecules. 2 The same. The Molecular motion considered as a Polar Oscillation. 3 All forces, modes of motion of material Masses or Molecules. The Ether and the Atmosphere one and the same.

Of these, the first five properly come under the head of early theories of electricity. Following no logical succession these have been, again and again, in various forms revived, and "how much ideas are bound up in words is shown by the use of the terms of one hypothesis in the expression of another."[3] In point of fact, terms belonging to each of them prevail more or less indiscriminately among modern electrical writers.

"Still the progressive stages in the history of general physical science account in great measure for the adoption, by the early electricians, of the supernatural, effluvial, ethereal, and fluid theories.

"The ancients, witnessing a natural phenomenon removed from ordinary analogies, and unexplained by any familiar mechanical principle, referred it to a spiritual or a supernatural power; and Thales expressed the

SUPERNATURAL HYPOTHESIS,

in attributing the phenomena of amber and the magnet, to a soul. Later, the functions of digestion, assimilation, etc., were supposed, by Paracelsus, to be effected by a spirit (the Archæus).

"The transition from the spiritual to the ethereal hypothesis occurred through the operations of the alchemists, who, seeking to convert ordinary metals into gold, subjected to intense heat various mixtures of substances in sealed vessels, which were almost invariably shattered to pieces by exploding. This frequent catastrophe was attributed to an antagonistic evil Geist (German) or spirit (English), to avert whose influence the divinity was appealed to by a cross usually marked upon the outside of the vessel. In course of time it was found that the Geist would escape harmlessly through even a minute opening left in the now so-called crucible (from Crux, a cross); and the word gas, a modification of the word Geist, applied to the escaping vapor after it became invested with a more material character, affords an instance 'of the gradual transmission of a spiritual into a physical conception,' which found expression in physics, in the tendency to attribute all mysterious natural phenomena to the escape, absorption, or chemical reactions of effluviæ, and introduced into electrical history the

EFFLUVIAL HYPOTHESIS,

one of whose earliest supporters, Robert Boyle, regarded electricity as an emanation of a subtile matter comparable with the emanations from volatile oils, flowers, and pungent acids or alkalies, as nitric acid or hartshorn, but especially characterized it as a glutinous emanation which seized little objects and carried them with it, upon its return, to the body from which it escaped.[4]

A certain Jacques Hartman, who published an article upon amber in the Phil. Trans.[5], pretended to prove by experiment, that the electrical attraction was produced by the emission of glutinous particles. He distilled a specimen of rosin, and found that the residue obtained was not electric, while the natural rosin, retaining its glutinous part, was a good electric.[6]

Hauksbee, in 1708, regarded electricity as an effluvium, which is developed from an object, such as a glass tube, or glass globe, when "affricated," and extends to a distance from the surface of the glass, both internally and externally forming, in case of a globe, a spherical envelope around it. Having some threads suspended in such an excited globe, which moved upon presenting the finger towards them from the outside, he inferred that the finger simply pushed the effluvium, and with it the threads, the interposed glass not interfering with the freedom of motion or continuity of its own effluvium.[7]

The hypothesis of an effluvial envelope, formed of an emanation from the excited electric, was favored by many of the early electricians, even to the time of Benjamin Franklin, who endeavored to effect a mixture of electric and odorous effluvia together, and was, therefore, not entirely disaffected toward this hypothesis.[8] But the effluvial conception gradually became still more materialized, "its further transition being assisted by Torricelli, who established the ponderable character of air and gases, and proving them analogous in many of their actions to liquids or known fluids, originated a tendency to regard them as aeriform fluids."

"No sooner was this conception established than a belief in the existence of other fluids, differing from air as air differs from water, insinuated itself in all branches of physics, and in explanation of every new phenomenon which presented itself a hypothetical fluid was immediately resorted to, and invested with such powers and properties as it might need to serve the desired purpose. Upon the idea of a fluid, thus was ingrafted a luxurious vegetation of imaginary offshoots."[9]

"The fluid caloric was long accepted as explaining the phenomena of heat. So was the luminous fluid at the same time as explaining the phenomena of light; but the falsity of all these conceptions is now considered quite certain, and though one of them satisfied the mind of Newton, it was condemned without hope of revival upon the day when Fresnel definitely formulated a more simple theory."

—— MR. G A. ROWELL, assistant in the Natural History Department, at Oxford, England, has issued a circular, calling attention to the suggestion made by him forty years ago, which says: "My views on the cause of auroræ, are that they result from electricity carried over with vapor by the superior trade-winds, from tropical to polar regions, and its occasional accumulation in the latter to such a degree as to flash back to lower latitudes, through the atmosphere at a reduced density, but still within the regions at which vapor is flotable although in a frozen condition. The directive properties of the magnetic needle I attribute to the return current of electricity from polar to tropical regions. The following is the concluding paragraph of the report on my paper on this subject: 'the author supports his opinion by general reference to the observations on the aurora, &c., in the appendix to Capt. Franklin's "Journey to the Polar Seas," and concludes with proposing the experiments of raising electrical conductors to the height of the clouds in the *frigid regions during the frosts in winter*, which in his opinion would cause the aurora to be exhibited and lead to important discoveries in the science of magnetism.'"—(*Report* of the British Association, 1840, *Transactions* of the Sections, p. 49.) In support of this theory, a foreign cotemporary refers to remarkable results recently obtained by Prof. Lemström, with a network of wires arranged up the face of the mountain at a station at Sodankyla, in North Finland. By this means he succeeded in procuring an appearance exactly similar to that of the aurora borealis.

3. Grove. Correlation of Physical Forces. N. Y., 1865. P. 95.
4. Joseph Priestley. History of Elec. 3 vols., Paris, 1771. Vol. 1, p. 13.
5. Abridgement. Vol. II, p. 473.
6. Priestley. Loc. Cit.
7. Hauksbee. Phil. Trans. London, 1708. P. 82.
8. Franklin. Works by Jared Sparks, Boston, 1837. Letters, vol. V, p. 250.
9. Grove. Loc. Cit.

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TELEPHONING AND TELEGRAPHING.

THE problem of simultaneous transmission over the same wire, without interference of telephonic and telegraphic messages, it can easily be imagined, is a most difficult one; and, from a telegraphic standpoint, we would be inclined to say, an impossible one. But, nevertheless, from received statements, the problem seems to be solved, and the credit appears to be due to two Canadian gentlemen, Messrs. Black and Rosebrugh, the former a practical telegraph electrician, and the latter with an established reputation as an oculist in the city of Toronto.

These gentlemen have been associated in this invention since the spring of 1878, and in February, 1879, together, took out letters-patent in the United States, and subsequently in England, for the claims covering the essential features of their invention. A separate patent was also issued to Dr. Rosebrugh, at the same time, for certain features of the invention, the application for which was filed, we believe, as early as May, 1878.

On account of certain patents still pending, some features of the invention are withheld from the public for the present. We may say in general terms, however, that the telephonic apparatus is inserted in branch lines; grounding of the Morse circuit being prevented by the use of condensers of low capacity, and the keys bridged by condensers, for the purpose of keeping the induced current circuit unbroken. A phantom, or induced current circuit, is formed on the Morse wire for telephonic purposes; and a way wire may be used as a "through" telephone line, or a "through" Morse line may be tapped at intermediate stations with telephone branches, and used also as a "way" line for telephone business.

Again, the apparatus may be inserted in a bridge between two parallel wires, and the wires used as a metallic circuit, the "crossing" of the wires being prevented by the use of the condensers.

For completing the telephone circuit, either to ground or simply bridging a key, it is found that a condenser of low capacity, say ½ a micro-farad is quite sufficient. Recent practical tests in New York, Washington, and Canada seem to demonstrate the practicability of the invention. Its great value can hardly be overestimated, and its bearing upon future telegraphy can not, for the present, be more than conjectured.

AT a meeting of the N. Y. Electrical Society, held at the society's rooms, corner of Liberty and Greenwich Streets, this city, on March 9th, Mr. Charles S. H. Small, Asst. Supt. Gold & Stock Tel. Co., was elected President for the ensuing year. The meeting then adjourned till Friday, March 16th, when the following gentlemen were elected: 1st Vice-President, Geo. B. Scott; 2d Vice-President, Dr. P. H. Vanderweyde; 3d Vice-President, James D. Reid; 4th Vice-President Edward C. Cockey; 5th Vice-President, William J. Johnston; 6th Vice-President, Gerrit Smith; Recording Secretary, Thomas R. Taltavall; Financial Secretary, James McKenzie, Jr.; Treasurer, Francis W. Jones.

Additional members of the Executive Committee: Edward C. Cockey, E. L. Bradley, Henry L. Bailey, and Gerrit Smith.

Owing to the lateness of the hour at which the election of officers was terminated, the reading of papers by Mr. Cushing on the "Gray Harmonic Telegraph," and by Mr. G. A. Hamilton on "CableTesting," were postponed until the next meeting. The Executive Committee have appointed Mr. Edward Blakeney, Librarian to the society.

OUR PARIS CORRESPONDENCE.

PARIS, March 10th, 1883.

EXPERIMENTS with M. Marcel Deprez's system of transmitting power to a distance by electricity, were lately made in the workshops here of the "Chemin de fer du Nord." We cannot speak of the results achieved from a full and personal knowledge, for, it is well-known, the data and calculations in such cases are only given to the public when they have previously passed through a beautifying process. As we have not been initiated into the secrets of the gentlemen who conducted the experiments, we must be content with what we could see in common with the other gentlemen invited. Well, our first impressions are by no means favorable. We have had a second edition in Paris, of the experiments made last October, between Munich and Miesbach; and the system of M. Marcel Deprez, does not seem to us to be one of those that improve with age. In Munich, a theoretical success was obtained, as the possibility of transmitting to a distance of 50 kilometres the force of a certain number of kilogrammetres by means of a simple telegraph wire, was amply demonstrated. No one had previously tried the experiment, which required a certain audacity—as it were. In Paris, with every possible facility at hand, we had a right to expect a conclusive and practical test, but we had to be satisfied with a mere blind trust in the experiments; to have volts and ampéres, measured on the terminals of the machines spoken about, and to have a lecture substituted for the dynamometer tests. Beyond this, there was nothing but mere gossip on a matter that is now well-known. There was little reason to disturb English electricians, and expose them to a most disagreeable trip across the Channel.

It will be of interest to trace the origin of this matter, and to show how it has developed since the Paris Electrical Exposition of 1881. At that time, M. Marcel Deprez was in the height of his glory; the Congress of Electricians furnished him with a splendid opportunity for having his merits appreciated, and every one seemed to recognize in him a first-class *savant*. He had discovered in electricity a field that had hitherto been but little explored, and one where his vivid imagination and theoretical knowledge could roam at will. He conceived the idea of a system for the distribution of power by electricity. It had seemingly—but only so—been utilized at the Palais d' Industrie, where sewing machines, lithographic presses and light machine tools were run by it. Visitors, having but an imperfect knowledge of electricity, were astonished at such liliputian contrivances.

A group of capitalists then determined to take advantages of these circumstances, and to facilitate the researches of M. Marcel Deprez, reserving to themselves any profit that might arise later from such initiative. They had—or they believed they had—the man for their purpose; the money was also forthcoming, and then the French Syndidate of Electricity entered on the campaign without any further reflection as to the final result of the enterprise. They were full of confidence.

There was every appearance of the matter proving a success in the early part of 1882. The Union Générale bank established the famous company for the utilization of natural forces, with a capital of 75 million francs. The company monopolized and absorbed every electrical system and improvement: Jablochkoff, Jamin, Werdermann, Reynier, Maxim, Weston, &c., while the distribution of electricity became its principal business, as well as that of M. Marcel Deprez. All these arrangements were upset, however, by the failure of the Union Générale, and the French

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Syndicate of Electricity was compelled to look out for a better solution

M. Marcel Deprez did not busy himself with the financial questions and difficulties of this time, but remained, what he was before, a *savant*, continuing his investigations and multiplying his experiments. He finished his theoretical studies on the characteristics of the dynamo-electric machines, planned new models, made a new Pacinotti machine, modified that of Gramme and established, on paper, calculations for gigantic machines, &c. The Munich Electrical Exhibition seemed to furnish an opportunity for bringing those laboratory improvements before the public.

M. Deprez stated, in 1881, that in transmitting power by electricity, the result was independent of the distance—that is to say—the distance and the intermediate conductor being given, he could always build his machines so as to obtain a given result. The conclusion is indeed supported by theoretical deductions, but it is not confirmed in actual practice. An axiom that has been denied by engineers was to be proved, and it was thus proposed with all the confidence that is instilled by mathematical calculations, to transmit motive power from Miesbach to Munich, a distance of over 30 miles, by a simple telegraph wire of 4 or 5 millimetres.

The experiment may be qualified as a scientific success, but the results from an industrial point of view, were very poor. It was a vain effort to try and confound the electric product (the proportion of the product of the volts and ampéres of each electric machine) with the industrial product—or the proportion of the number of kilogrammetres furnished by the motor at Miesbach, with that of the kilogrammetres measured on the shaft of the receiver at Munich. The gentlemen interested in the matter would not be led astray, and the rather fanciful deductions that were made from the figures, were rather severely criticized. It must be admitted that the friends of M. Marcel Deprez contributed in a great measure by their undue zeal to bring these experiments into discredit. They gave at the very outset a return of 60 per cent., while the certificate delivered a few days ago by the Munich Electro-Technical Committee gives no more than 38.9 per cent; and even then, only the electrical result is meant—that is, that the volts and ampéres were measured at the terminals of each machine, and the proportion of the volts and ampéres of the two machines was taken, and making allowance for all resistances, and only then, was this figure of 38.9 per cent. arrived at. It was even admitted that there were no losses on the 50 kilometres of the conductor; which, with the tension employed, cannot surely have been the case. The Electro-Technical Committee, in the only experiment that they cite, observed a return of 0.25 horse-power on the dynamometer in Munich; but they do not tell us how many horse-power were furnished by the motor at Meisbach. This fact, which was the only important one from an industrial standpoint, remains undecided, and thus the Munich experiments have really no practical value in our opinion They have, however, been useful, in so far as demonstrating the possibility of the electric transmission of power to a distance.

We believed that the new experiments, that were made by the "Chemin de fer du Nord," in Paris, would give us more complete data for forming an opinion, but we must say that such have been wanting up to the present. There has been even a lack of knowledge shown in the manner in which the machines have been put up. Instead of having the generator worked directly by a stationary engine, the power of which could be measured by the dynamometer and diagrams, the power was taken from a countershaft in the shops, so that the horse-power furnished co ld not be exactly ascertained. The generator and the receiver were, moreover, placed near one another, and connected, on the one hand, by a line-wire, of a variable length, of from 20 to 30 kilometres, and on the other, by an insulated cable of a few metres in length. The very conditions for practical tests were not fulfilled here, while they were in Munich. It is true that this is a very easy way to reduce the losses by the conductor.

The non-scientific papers published long and enthusiastic articles—at so much a line—on these tests. A return of 50 per cent was spoken of; and it was stated that of 10 horse-power received by the generator, 5 were returned by the receiver. We cannot conceive how such conclusions as these could be arrived at from the foregoing data, unless by measuring volts and ampéres on the terminals of the machines, which is a very simple but misleading proceeding.

Whenever electric transmission has to be made, it must be borne in mind that manufacturers, and not professors of natural philosophy, have to be satisfied. The return that we have to obtain, or determine, is not, therefore, the standard proportion of the products, $E\ T$, but the proportion of work furnished at one extremity, to the work received at the other. The manufacturer cares but little about the intermediate agent; it may be electricity, gas, compressed air, water, or steam; he only looks for kilogrammetres; he does not want to know how they come, but how much they cost, and the dynamometer can alone give him the necessary information in this respect. To adopt any other method of operating may, indeed, be a work that proves a *savant*, but not an engineer; and the mistakes and errors that have been already caused by the Munich experiment, ought to have shown M. Marcel Deprez, that in following up the same wrong path he would only expose himself to another failure.

PH. DELAHAYE.

SPEAKING TELEGRAPHS.

SOMERVILLE, MASS., March 6, 1883.

To the Editor of the Electrician.

I have copied the subjoined item from *Gleason's Pictorial* (Boston), issue of April 17, 1852.

It is, at least, an early suggestion of a speaking telegraph.

Yours, truly, FRED. W. STONE.

THE French and English journals are speculating on the practicability of turning the electric telegraph, that connects England and France, via the channel, into a medium of conversational intercourse. The *modus operandi* is this: A plate of silver and one of zinc are taken into the mouth, one above, and the other below the tongue. They are then placed in contact with the wire, and words, issuing from the mouth so prepared, are conveyed across the Channel by the way—in a whisper, we suppose, though the account does not say. It has been tried, it is said, with successful results.

—— THE LONDON *Electrical Review* says: The Force and Light Company, controlling the storage battery patents of the French inventor, Faure, are at present engaged in legal warfare with an English company claiming to have rights in the Faure patents, and with the Brush Company, which has lately put a storage battery, said to have been invented by Mr. Brush, into the market. The Brush Electric Light Company have made common cause with the Swan Electric Light Company of England against the Edison Company, which latter organization is suing the Brush Company for using a lamp (Swan) somewhat like Edison's, while the Force and Light Company is suing, because Brush wants to light his Swan lamps from a battery which resembles Faure's.

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TABLE OF C. G. S. AND ENGLISH UNITS.

BY BRADLEY A. FISKE, U. S. N.

1 Gramme = 15.432 grains.
1 Gramme = 981 dynes.
1 Lb. = 445,900 dynes (approximate).
1 Dyne = .00000224 + lbs. (approximate).
1 Grain = .0648 grammes.
1 Metre = 39.37 inches.
1 Kilometre = 1093.6 yds.
1 Erg = 1 dyne-centimetre.
1 Foot pound = 13,586,850 ergs of work = 13 + meg. ergs.
1 Foot pound = .1385 kilogrammetres.
1 Kilogrammetre = 98.1 meg. ergs.
1 " = 7.220 foot pounds.
1 Volt = 10^8 c. g. s. units.
1 Ohm = 10^9 " "
1 Ampére = 10^{-1} c. g. s. units.
1 Coulomb = 10^{-1} " "
1 Farad = 10^{-9} " "
1 Calorie = 42 x 10^6 ergs = 1 gramme water 1° C.
1 Eng. heat unit = 772 foot pounds = 1 lb. water 1° F.
1 Horse-power = 550 foot pounds per second.
1 " " = 33,000 foot pounds per minute.
1 " " = 1,980,000 foot pounds per hour.
1 " " = 76. kilogrammetres per second, English measure.
1 Horse-power = 75 kilogrammetres per second, French measure.
1 Horse-power = 7,460 meg. ergs per second, English measure.
1 Horse-power = 7,357.5 meg. ergs per second, French measure.
Unit of electrical *work* = volt-coulomb or vomb (suggested).
1 Vomb = .737 foot pounds.
1 Meg. vomb = 737,000 foot pounds.
Unit electrical *energy* = volt—ampére or watt.
1 Watt = 10 meg. ergs per second = $\frac{1}{9.81}$ kilogrammetres per second = $\frac{1}{746}$ horse-power.

59, Astor House, New York.

THE AURORA AS AN ELECTRICAL MANIFESTATION.

CHICAGO, March 15, 1883.

To the Editor of the Electrician.

DEAR SIR:—The sixty-fourth regular meeting of the Chicago Electrical Society was held February 19, in the lecture hall of the College of Pharmacy. The subject for the evening was, "The Aurora as an Electrical Manifestation." The paper bore evidence that the lecturer, Mr. C. C. Haskins, had carefully studied his subject, and acquainted himself fully with the most popular and widely accepted theories concerning the nature and causes of these natural displays, basing his paper largely on M. Angot's recent writings on this subject, from which source he also procured the illustrations.

The spectroscope has shown that the theory of reflection, which has, until recent times, obtained very general acceptation, is untenable, the spectrum lines of the aurora, differing from those of the sun-light in several important particulars. The theory that it is caused by the passage of currents of electricity between the earth and the upper atmosphere, explains more nearly than any other, all of the known facts and manifestations. The lecture was fully illustrated.

The *Chicago Tribune*, in giving an abstract of the lecture, says: "Mr. Haskins divided auroral lights into two grand classes—those having comparatively little movement, and those of a more restless or active character. The various forms of polar light include faint, indefinite illuminations, those resembling cirrus or cirro-stratus clouds, arches of light reaching from horizon to horizon, arches with radiations, rays of light which converge to some point in the heavens, and lastly, light bands not homogeneous, composed of many rays closely crowded together. These various forms mingle in different proportions, a display often exhibiting two or more of these species.

Of the first or indefinite illuminations, there are varieties; sometimes a bright crimson light covers the entire heavens; again, the light may be like that of tardy northern twilight, and occasionally of a phosphorescent character. The cloud-like auroras are vague, indefinite in form, sometimes dense, often resembling tufts of cotton-wool, and numerous instances are recorded where doubt has been raised as to their actual character. Cirrus clouds often show colors through the medium of ice-crystals in the air. Similar results may be had by viewing the sun or moon through frosted window panes.

Sheets or bands of light exhibit at times a restlessness of great beauty—dilating and contracting like sea-polyps in swimming. A mass of light of this description, of a roseate hue, was seen about seven feet above the surface of Lake Wetter in July, 1877, which crossed to the wooded shore, about 2,400 feet, in about two seconds, the phenomenon being twice repeated. The records of Ross' expedition mention a light of similar character, which the vessel sailed through without harm.

Mr. Haskins described the various forms mentioned, citing cases and fully illustrating them by means of slides and the oxy-hydrogen lantern. A series of these plates, taken at short intervals, showed the evanescent character of some of these displays during one night. He cited cases where one form of aurora was duplicated as many as nine times, on one occasion, in different parts of the heavens, as recorded by the officers of the Search.

One form was illustrated by a picture representing a huge semi-circular cloud, pierced by rays or fires, like streams of water from a rose-nozzle. The ancients deemed this arch the cavern from whence the gods launched the fires of heaven.

THE DRAPERY FORMS,

the most beautiful of all the auroras, closely resemble delicate frills and lace work, like curtains, suspended, gracefully folded back upon themselves, were shown upon the screen in great variety. The hues of auroras are varied, extremely delicate, and pure. White, shaded into yellow, is by no means uncommon. Next in order ranks carmine-red, while green, violet, and blue are less common, but often seen. The spectroscope resolves the auroral light into bands or lines which are bright red, bright yellowish-green, a second faint green, a very brilliant green, bright greenish-blue, a still brighter pure blue, and a violet, lighter in the centre, deepening toward the edges. By the instantaneous process, the aurora may be photographed.

The extent of auroral fields is extremely variable. Cases were mentioned where expeditions in the same general locality failed to witness the same display—notably the Alert and Discovery wintering in Smith's Straits, only sixty miles apart. During the entire period of their sojourn, only seven simultaneous instances were recorded, while the aurora of Aug. 28 and 29, 1859, was seen at the same hour all through Europe, in Western Africa, in the Atlantic, Cuba, and North America. On another occasion, a Northern aurora—February, 1872—was witnessed throughout Europe, North Africa, and the Atlantic, while a Southern display was visible in Australia, Mauritius, Reunion, and Natal. The two displays were separated by a zone of only twenty degrees either side the equator.

A circum-polar map on the screen showed lines of comparative frequency, increasing with increasing latitude, until a line of no aurora is reached. North of this, all displays are seen in a Southerly direction. The centre of this curve is found to be nearer the magnetic than the geographic pole. On this fact hinges

THE THEORY OF THEIR CAUSE.

Particular forms of these lights are more prevalent in certain localities. North of Behring's Straits the displays are nearly all of the homogeneous

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arc type, while the drapery form affects those regions like Northern Norway, Novazembla, Franz Joseph's-Land, and the East of Greenland, where the seas remain unfrozen.

Terrestrial currents are often, but not always, present during these displays. The current storm of November 17th and 18th last year, which interfered with all the telegraph lines in this country, from Nashville North interfered with all European lines, from the British Islands to Norway, and auroral lights were visible there, except where daylight extinguished them. During that storm, hundreds of miles of telegraph lines were worked, either practically or experimentally, from nature's own reservoir batteries, and an Edison lamp, burned at Milwaukee, from an earth current, at about one-eighth its illuminating power.

Abundant testimony seems to point to the conclusion, that the magnetic force of the earth has a decided bearing upon the direction of these lights. Meteorological conditions possibly—nay, probably—do, to some extent, influence them, but, so far, this connection alone is well authenticated: C'ouds may replace auroras at the approach of day, and these in turn give way to auroras of the same shape at nightfall.

THE MANY THEORIES OF AURORAS

are grouped into four classes: Cosmical, optical, magnetic, and electrical. The cosmical, which attributes their production to causes exterior to our earth, before being accepted must answer, Why do they not then have an apparent orbital movement, like other heavenly bodies?

The second, which assumes them to be mere light reflections, is disposed of by the spectroscope, which fails to find the requisite evidence in their spectrum.

The magnetic theories fare little better. The assumption that showers of ferruginous powders form the media of equalization between the surcharged upper air and the earth, is met in objection by the fact, that in localities where such showers are quite frequent, few auroras are seen; and again, that at the magnetic North Pole, where the power of attraction is most potent, there are none at all.

The electrical theories seem better to answer the requirements of the problem. The well-known Geissler tube, which shows the electric spark as a continuous, feeble, milky, or colored light, in its passage through various rarified gases, is the best aurora in miniature which has yet been conceived. Varying the gases will vary the colors."

The lecture was fully illustrated by a large number of lantern projections, exhibiting the most noted and striking forms of the Aurora which have been recorded by observers in all parts of the world. At the close of the paper the lecturer made several experiments with the Holtz machine; and by means of a Geissler tube, three feet long and two inches in diameter, containing rarified nitrogen gas, he showed a beautiful brush aurora, and some of the other forms.

He also showed a beautiful experiment, new to nearly all of the audience, exhibiting the glass tube previously referred to as a Leyden jar. After charging it from the Holtz machine, he discharged it by passing his hand over the tube, obtaining a fine brush light wherever the hand approached the tube. He also excited the charged tube to luminosity, by breathing on it, obtaining a fine light, through the induction thus set up. This experiment shows why we do not have auroras at all times—movement of the current is necessary to develop the luminous properties.

At the close of these experiments, Prof. N. Gray Bartlett exhibited on the screen, the spark of the Holtz machine, by means of magnifying lenses. When the spark was short, its course was perfectly straight; but as the distance between the points was increased, the track of the spark became very irregular.

The audience, which was very large, seemed to feel that they had been amply repaid for their time and attention.

THE SCRIBE.

—— THE TELEPHONE has achieved a wide degree of usefulness in Cincinnati. One hundred and thirty villages, within a radius of 75 miles, are within speaking distance of the city.

CAUSES OF DANGEROUS CHARACTER OF INTERMITTENT CURRENTS.

IN a lecture recently delivered at the London Institute, Professor Ayrton explained, in a very clear and striking manner, the reasons why an intermittent current is so much more dangerous than a continuous one of the same electro-motive force. We take the following extract from an account of the lecture published in the London *Electrical Review*:

"The danger arising from the use of high potential can be very much diminished if, instead of using the earth as part of our return circuit, we employ not only an insulated wire to convey the current, but also another insulated wire to bring it back again, and if, in addition, the current flowing through the whole circuit is not intermittent. This may be shown by the following experiment: Attached to these wires, well insulated from the ground, are the insulated coatings of this battery of charged Leyden jars. Now, although the difference of potentials between the wires is some thousands of volts, far, far greater than is at present used, or proposed to be used, in any system of electric transmission of power, I can, as you see, touch either wire with perfect impunity. But if either of these wires be replaced by a wire in contact with the earth, say replaced by one of the gas pipes, and I were now to touch the other, I should receive a violent shock.

"As, however, my love of electric experiments does not extend to shocks, I will touch the insulated wire by deputy, using this metallic rod, and the result is, you see, a bright spark. [Experiment shown.] Both the going and return wires, therefore, should be insulated.

"But next, the current flowing in them must not be discontinuous, if danger is to be avoided. For, if, instead of keeping the difference of potentials between any two points in the two insulated wires constant, I allow rapid fluctuations in this difference to take place, then, no matter how well the wires be insulated, a violent succession of shocks will be received on touching either of the wires, even although the other be not touched, so that no circuit in the ordinary sense is completed through the body. To show this experimentally, I shall replace this insulated battery of Leyden jars with an induction coil, which, as well as the voltaic cells used in charging it, are thoroughly well insulated from the earth in every part. Let me, however, touch either of these wires—again by deputy—and you see bright sparks passing to the earth. [Experiment shown.] Bear in mind that I am touching one wire only, not both, so that although the Ruhmkoff coil is doubtless an old friend to you, I am using it to-night in a new way to illustrate my point.

"Now let us consider why it is that when a current goes and returns by a wire completely insulated from the ground, no shock is experienced when the current is perfectly steady, even if a bare part of the wire be touched; but if there are rapid variations in the current strength, severe shocks are felt, even if only one part of the wire be touched.

"In each case the effect of touching the wire is to reduce the potential of the point touched to that of the earth, and to effect a corresponding alteration of the potential along the whole line. This means the addition to, or a subtraction of, a certain quantity of electricity from the wire. In the case of a perfectly steady current, this operation only occurs *once* for once touching the bare wire, and unless the electro-static capacity of the wire be very great, or the potential of the point touched immensely different from that of the earth, this *single* addition or subtraction of electricity produces hardly any perceptible feeling. But in the case of a varying current, the potential of the point would naturally be undergoing constant variations of potential, so that in order to keep the point touched at the same potential as that of the earth, constant additions and subtractions of electricity are necessary, and if these occur with sufficient rapidity, a severe shock is produced, even although the body forms no part of the main circuit.

"A single puff of air through this syren produces no audible sound; a rapid succession of even minute puffs, a loud roar; so the single small electric discharge is not perceptible, but the rapid shower of liliputian arrows is terribly painful. This, indeed, is the same analogy Professor Perry employed in his lecture at the Society of Arts to prove the powerful

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action of rapidly recurrent effects in connection with our method of signaling to ships by means of sound waves, sent through the water itself.

"High potential, I have explained, is absolutely necessary for economy in electric transmission of power, and I hope I have also made it clear to you, that contrary to the received opinion, this high potential is not, necessarily, at all dangerous to life, if the currents employed are not at all discontinuous But the discontinuity of current we have to deal with is not merely the discontinuity that exists in the so-called reverse current machines. Even many dynamos, like the Brush, do not produce a really constant current, although generating a current of sufficient mean constancy to cause a perfectly steady deflection on one of the ordinary ammeters of Professor Perry and myself, an instrument, be it remembered, so dead-beat that it records with perfect accuracy the change of current produced every time the joint in the driving belt passes around the pulley of the dynamo, as well as the regular increase of current at each of the explosions of the gas in the cylinder of a gas engine.

"The variations of current, I am now referring to, occur many hundreds of times a minute, and although they cannot be detected by ordinary current meters, and although but little attention has been given to them, they are, in my opinion, a source of great danger when the dynamo produces a high electro-motive force.

"In any machine for the mechanical production of electricity a coil must, as you no doubt all know, be alternately rapidly brought up to a magnet and then withdrawn. Bringing up the coil produces a current in one direction in the coil, and withdrawing it, a current in the opposite; and, although by a simple piece of mechanism, called a commutator, the direction of the current in the external, or useful portion of the circuit may be always kept the same, even although the direction of the current is alternately reversed in the coil, no mechanism can make the coil produce a current at the moments of rest, when it changes its direction of motion. Wheatstone, in 1841, proposed to overcome this difficulty by combining two or more dynamos in series, like the two cylinders of a steam engine, in such a way that the current produced by the one was strongest when the current produced by the other was weakest; but Pacinotti, in 1860, showed us scientifically, and Gramme, in 1870, practically, how to combine a number of moving coils in one machine, so as to give a current comparable in steadiness with that produced by a voltaic battery. The power of any dynamo depends roughly on the speed at which the coils move, and on the strength of the magnetic field in which they move. Now, from the construction of the well-known Gramme machine, the strength of this magnetic field is necessarily weak when the machine is made of large size, so that the greater power and efficiency which ought to come from enlarging the machine, is partially compensated for by the relatively weaker magnetic field; indeed, even in a small Gramme machine, the magnetic field is probably weaker than the magnetic field produced long ago in the old reverse current machines of Holmes and Wilde. Hence, more recent inventors, like Brush, have adopted a compromise between the perfect uniformity of strength of current obtained with the Gramme dynamo, and the strong magnetic field in the old reverse current machines. But, in almost all the high electromotive force dynamos, continuity of current has been somewhat sacrificed to strength of magnetic field. The plan, however, described in 1879 by Prof. Perry and myself, of oblique coiling of the armature, has enabled us, especially in our recently constructed machines, to combine the continuity of current, produced by a Gramme, with the powerful magnetic field necessary for obtaining high electro-motive force, and these results are in no way diminished when the machine is increased to the size necessary for utilizing hundreds or thousands of horse-power, and for obtaining that high efficiency which, both theory and practice show, is obtainable with the use of very large dynamos.

"The next point to consider is, how can we measure the amount of this dangerous discontinuity in the current produced by a dynamo, without having to resort to the inconvenient process of killing off a certain number of people. We want a 'discontinuity meter,' and such an instrument I have here, employed by Prof. Perry and myself for this purpose. It consists simply of an induction coil in which both the primary and secondary circuits are of thick wire. The one is put in the main path of the current, the other is attached to one of our 'spring ammeters,' which measures the mean square of the strength of the reverse currents produced in the outer secondary coil by the intermittencies of the main current.

"Now, what are the results obtained when such an instrument is practically employed? Why, we find that when a current of ten ampéres produced by a three-light Brush dynamo is flowing through the primary, there is a reverse current through the secondary which increases to about five ampéres, when the secondary is nearly short circuited, and which, be it remembered, is produced merely by the commonly ignored discontinuities in the current in the main current produced by the Brush machine. On the other hand, when the same current, ten ampéres, is sent through the primary by a Gramme machine, running at about the same speed, no visible current, certainly not a quarter of an ampére, is produced in the secondary. Hence, it is clear that the continuity of the Gramme current is immensely greater than the continuity of the Brush current.

"A telephone may also be used as a discontinuity meter, the two terminals of which are, in different experiments, attached to two points close together in the main circuit of the dynamo. For quantitative experiments these two adjacent points in the main circuit should be selected, so that in all cases there is the same difference of potentials between them, and then the pitch of the note heard in the telephone will tell the number of variations per minute in the main current, and the loudness of the note the magnitude of such variation.

"And I strongly advise any one who is procuring a high electromotive force dynamo, to ascertain for himself before purchasing, the magnitude of the discontinuity factor of the machine, and about which he will find no information, as a rule, given in any description of the machine"

THE VIENNA ELECTRIC EXHIBITION.

THE Vienna correspondent of the London *Standard* refers to the exhibition at Vienna, as follows:

"The Crown Prince, (Rudolph), who is now on a visit to Berlin, will communicate with the German committee, which, with the help of the Electro-Technical Society, and men like Dr. Werner Siemens, is expected to bring together a great collection of the most important recent appliances. The Americans will also probably take a prominent part in the exhibition, but, owing to the great distance, they are among the latest to send in their announcements. Although England, Germany, and America are all late in their applications, the Vienna committee have sufficient promises to make it pretty certain that those countries, in common with the nearer Continental States, will be well represented. Such an opportunity, in fact, as the Vienna exhibition will offer for the extension of the electric light and other applications of electricity in the East of Europe, in Russia, Roumania, Servia, Greece and Turkey, as well as in Austria and Hungary, is not likely to present itself again for a long time to come. The exhibition will be held in the Prater, the great park of Vienna, and the favorite resort of the vast population of the city throughout the summer. The building in which the display will be collected is the rotunda, the largest covered hall upon the European continent. The space over which this edifice extends is more than a quarter of a million square feet, being more than double the area available at the late exhibition at Munich. Among the principal features of the exhibition I may mention, in the first place, the exhibits of M. Marcel Deprez, whose developments of electric art in the way of transmission of electric power are among the most important of recent times. At Munich, M. Deprez was able to use in the exhibition the water power furnished by a small cascade thirty-five miles distant, the medium of transmission being nothing more than an ordinary telegraph wire. The loss of power, then, however, was slightly over sixty per cent. By the help of improved machinery, he has already reduced this loss very considerably, and he expects to show still better results at the Vienna exhibition, where his experiments will be shown on a grand scale, and where he promises to prove to demonstration the entire correctness of his views on the transmission of electric force. There will likewise be rivals in the same section in the persons of M. Gravier, of Warsaw; M. Ganz, of Pesth; and M. Krizik, who is already known as the inventor of the Pilsen lamp. M. Gaston Planté, inventor of the accumulator, and M.

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Gautheret will also be among the exhibitors in this new field. Another department, in which much that is novel and surprising will be shown, will be that having to do with scientific measurements connected with electricity. Since the Munich exhibition there has been remarkable progress made in this section, which will be fully illustrated in Vienna. The measurement of the degree of light in the various electric systems will here be illustrated. There will also be a few new systems of electric lighting shown, both of the arc and incandescent descriptions. Messrs. Krizic and Scoda, of Pilsen, will show a single arc light equal to twenty thousand candles in effect, and produced by a sixty horse-power engine. The Société Anonyme, of Paris; Edison's Company, of New York; and Deckert and Thomalto, of Vienna, will also compete with various novelties in this department. Another interesting portion of the exhibition will refer to new applications of electricity for various scientific purposes, including electric optical instruments, medical appliances, apparatus for the examination of the interior organs of the body, and electrolithic batteries. There will also be new electric railway signals, electric rail shifters, point indicators, electric type printing with single wire, and a new phonophone for musical transmission. There will be an electric railway running through the principal avenue of the Prater to the exhibition. Some of the Vienna theatres are also to be connected with the rotunda by telephone, so that the performances may be heard in the exhibition. The Baden theatre, ten miles distant, will be similarly connected. From this somewhat brief sketch, it will be seen that the Vienna Electrical Exhibition of 1883, promises to be full of interest, not to the electricians and specialists only, but to the traveling public generally."

Applications for the receipt of space, were extended from the 1st to the 20th of March.

EXPERIMENTS WITH ELECTRIC LIGHT ON PLANTS.

THE *Journal of the London Chemical Society*, for January, gives an abstract of a paper by M. P. P. Déhérain, of experiments made in a conservatory during the electric exhibition at Paris, in August, 1881: A greenhouse was constructed and divided into two compartments, one of which was glazed with blackened perfectly opaque glass, whilst the other was exposed to the ordinary diffused daylight of the exhibition building. The darkened chamber was illuminated continuously, night and day, by a 2,000 candle arc light from a Gramme machine, driven by an Otto gas engine. The transparent chamber was illuminated at night only by the electric light. Five series of observations were made, viz.: 1. Plants exposed night and day to the electric light alone. 2. Plants exposed during the day to the diffuse daylight of the Palais, and during the night to the electric light. 3. Plants living during the day in the open air, and receiving the electric illumination at night. 4. Plants passing the day in the diffuse daylight of the Palais, and the night in darkness. 5. Plants living normally in a garden. The plants submitted to experiment were barley, flax, beans, and a number of garden and greenhouse plants. At the end of seven days, the naked electric light was seen to have an injurious effect both on those plants which were constantly subjected to it, and in a less degree on those which were exposed to it during the night only. The leaves blackened, withered, and dropped off; the injury was confined to the epidermal layers, and was due to the direct impact of the luminous radiations (and not to the formation of nitrogen oxides); for, where one leaf was partly shaded by another, a sharp line was photographically impressed. Experiments on *elodea canadensis*, submerged in flasks of water, showed that whilst the diffuse daylight of the building was unable to cause decomposition of carbonic anhydride and evolution of oxygen, the direct rays of the electric light were able to do so; about as much oxygen being obtained during an exposure of four or five days and nights to the electric light as could be obtained in an hour or so in bright sunlight. At the end of fifteen days the arc lights were enclosed in globes of transparent glass, Siemens's just published experiments having shown that the injurious action of the direct radiations was thereby modified. A number of fresh and uninjured plants were placed in the greenhouse, and, in addition, sowings of barley, oats, peas, maize, beans, which had just appeared above the ground. All the seedlings exposed exclusively to the electric light, perished sooner or later, and the leaves of some of them were blackened as with the naked light. The mature plants, on the other hand, continued to vegetate, but in no case, save a plant of barley, were flowers and seeds produced, the vegetation being purely foliaceous. The barley grains were normal, and germinated on being sown. The electric light employed was clearly insufficient by itself to determine the assimilation of any considerable quantity of material. Direct experiments also proved that it is not more powerful in exciting transpiration of water, a leaf exposed to it giving off in an hour only about one-fiftieth of the quantity of water evaporated under similar circumstances in sunlight. As the evaporation of water by the leaves is one of the chief agencies in causing the migration of material necessary for the maturation of seed, the failure of the plants to produce flowers and seeds receives its explanation. It is known that yellow and red rays are most powerful in causing transpiration, whilst the electric light is particularly rich in blue and violet rays. The author considers the electric light employed as too feeble to allow of any conclusion as to the necessity of a nocturnal rest to plants. It was, however, evident that the electric illumination during the night was advantageous to those plants which passed the day in the rather feeble diffused daylight of the Palais. In a third series of experiments, the intensity of the electric light was practically augmented by placing the plants nearer the lamp. The experiment was again fatal to young seedlings receiving the electric light exclusively, but many of the hardier and more mature plants survived, although the leaves of some were blackened by their too great proximity to the light; and again the nocturnal electric illumination was decidedly favorable to the plants which passed the day in the light of the Palais. The author sums up his conclusions thus: 1. The electric-arc light emits radiations which are injurious to vegetation. 2. Most of these radiations are arrested by colorless glass. 3 The electric light emits radiations powerful enough to maintain mature plants in vegetation for two months and a half. 4. The beneficial radiations are not sufficiently powerful to cause the growth of germinating seeds, or to allow of the maturation of fruit in older plants.

ON THE CHARACTERISTICS OF INDUCTED CURRENTS; RESULTING FROM THE RECIPROCAL MOVEMENTS OF TWO MAGNETIC BODIES PARALLEL TO THEIR AXIS.

IF one of the poles of a permanent magnet be passed lengthways before a straight electro-magnet, that has its spiral connected with a galvanometer, we shall have three inducted currents successively developed. The first of these currents is caused by the approach of the inducting pole, and corresponds to an *inverse, or magnetizing*, current; a second current results from the movement accomplished by the inductor, from one end to the other of the electro-magnet, and which is in a contrary direction to the first, while a third is shown at the moment of separation from the inducting pole; and which, although in the same direction as the first, is *direct*—or corresponding to a demagnetizing effect. This latter is in the same direction as the first, because the action, being effected in both instances on the dissimilar ends of the electro-magnet, the effects which should be inverse, are rectified thereby. If a movement be now imparted to the inducting pole, that will comprise the totality of the three movements which we have analyzed, the galvanometer will indicate *but a single current, the direction of which will correspond with that produced by the inducting pole, proceeding from one end to the other of the core*, and it is the strongest, because it arises from the reaction that has taken place nearer to the magnetic core of the electro-magnet, and is developed with the same intensity during the entire course of the inducting pole. This current belongs to the class of currents that I have designated by the appellation of *polar inverted* currents.

If the iron core of the straight electro-magnet be polarized, by placing it in contact with one of the poles of an electro-magnet, or powerful magnet, and the above-mentioned experiments be repeated, we shall perceive that

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this polarization does not exert any influence on the direction of the inducted currents that are developed; their intensity alone varies, being less when the poles that are opposed to one another, in the movement of the inductor, are of the same name, and greater when these poles have contrary names. *Only the nature of the inducting pole, or the direction of the roll of the spiral of the electro-magnet, exercise any action on the direction of the currents,* and it can be easily proved that these effects are due to the polarity action of the inductor, for if a piece of soft iron is substituted for the inducting magnet, it will be seen that the currents arising from the preceding experiments *vary in direction according to the polarities of the core of the electro-magnet.*

It results from this, that the polarization of an iron core renders a certain quantity of magnetism immovable, and which is, consequently, unaffected by the dynamic excitement that is produced by exterior magnetic reactions, and which is only influenced when acting on the inductor itself, which over excites its energy, it can polarize it in turn, so that the action and reaction are effected in a concordant way. It is very singular that a *very weak magnet may produce the actions which we first explained,* and which, as we have seen, are very different from those produced by soft iron.

One consequence may be deducted from this kind of effects, viz.: that the inducted currents, that are due to the approach of the inductor to the polarized core, are in the same direction as the current which produced the magnetizing of the latter, when the opposite poles are of the same name at the moment of approach, which is the inverse of the ordinary cases of magneto-electric induction. This fact may explain, perhaps, how the motor in Griscom's electro-motor profits by all the inducted currents that are developed in it.

I wished to ascertain whether the foregoing effects were the same for a *closed* electro-magnetic system and an *open* electro-magnetic one. I, for this purpose, polarized the straight electro-magnet, sometimes by a single pole, and again by both poles at once. In the latter case, I placed the straight electro-magnet between the poles of a horse-shoe electro-magnet, arranged for the purpose. The system was then *closed*, and when one of the extremities of the electro-magnet touched one of the poles of the same magnet in horse-shoe shape, the system was *open*. By repeating the above experiments, I found that the effects, with regard to the direction of the inducted currents produced, were always the same, but that the relative intensity of the currents were very different.

Thus, the currents due to the approach of the inductor, which, with poles of contrary names present and the magnetic system open, are more energetic than when these poles are of the same name, become, on the other hand, less energetic with the magnetic system closed. A similar effect is produced when the non-polarized system is acted on. The currents produced by approach are then almost double the intensity with the open than with the closed system, which is easily understood, when it is considered that in the open system, magnetizing by influence is only effected on the core that is covered by the spiral, while with the closed system, it is divided between the two cores.

When, instead of reacting on the complete electro-magnetic system—that is, on the system provided with the iron core—we operate the inducting pole on the spiral only of the straight electro-magnet, we have the effects again that we first analyzed, but the inducted currents that are produced, give only galvanometric deviations, that are scarcely perceptible from 2° to 3°, and the current resulting from the three combined movements is almost null. This proves that the action of the magnet on the wire is infinitely less than it is on the magnetic system that occupies the centre of the spiral

TH. DU MONCEL, in *L'Electricien.*

—— THE *Herald*, March 27th, says: The Postal Telegraph Company yesterday opened its line for private test between New York and Chicago and everything worked perfectly. The resistance of the wire showed only 1,522 ohms, as against 6,000 ohms on the best iron wire an l 15,000 ohms on the average iron wire. Professor Elisha Gray and H. Crimmins, Vice-President and General Manager of the Postal Telegraph Company, conversed freely and distinctly with Mr. Taylor, the company's electrician in Chicago, a distance of 1,000 miles.

SPARKS.

—— IN ONE WEEK, recently, the number of messages sent through the telephones at the London exchange reached the enormous number of 40,000 daily.

—— MORSE, who invented the telegraph, and Bell, the inventor of the telephone, both had deaf-mute wives. Little comment is necessary; but just see what a man can do when everything is quiet.

—— THE LIGHTHOUSE BOARD has leased the property at Hallett's Point, Hell Gate, New York harbor, selected as a site for the new electric light tower, the erection of which will soon be commenced.

—— THE CONNECTICUT LEGISLATURE is considering a bill compelling telegraph companies to keep their offices, in towns of 6,000 inhabitants, open all night, and to furnish messengers at all times.

—— THE *Journal Télégraphique du Bureau Central de Berne*, summarizing the principal lacunæ in the universal system of telegraphy, notes as one, the construction of a line to Iceland, for recording the principal atmospherical events observed in the polar regions.

—— THE *Providence Journal* congratulates its city on doing, for its size, more "halloing" than any city in the world. There is a telephone subscriber to every 72 persons, while it is one to every 253 in Boston, to every 400 in New York, to every 471 in Paris, and to every 2,563 in London.

—— IN THE REPORT of the Mass. Railroad Commissioners, issued last week, much attention is devoted to the use of electric signals on the roads which are provided with them, and their general use is strongly recommended. This is as strong as they can state the demand, as the powers of the board are only advisory.

—— WHEN IRON IS MAGNETIZED the re-arrangement of the molecules, due to magnetization, produces a slight noise. In some experiments, with an alternating current dynamo, the continuous reversals of magnetic polarity in the iron core of an electro-magnet, produced a crackling noise, similar to the bending of a bar of block tin.

—— IN ARRANGING electric lighting circuits for interior use, especially mills and industrial establishments, care should be taken to arrange the lamps in the darker portions of the buildings, and those lamps in the better lighted places, on different circuits; so, that on dark days, and mornings and afternoons, one dynamo can be used at its best advantage.

—— HERE IS A HINT for telephone operators. A paper has been circulated in Keene, N. H., with the following heading: "We, the undersigned, in consideration of the kind and patient cheerfulness of Miss ——, shown at all times to all by the tone of her voice, do cheerfully pay the sums," etc. It was crowded with signatures, representing a handsome sum of money in the aggregate.

—— THE FRENCH GAS COMPANIES have instituted at their common expense, a laboratory for testing the several inventions reported in electric lighting, and proving whether they are valuable or not. After alluding to this foundation, and the much spoken of experiments tried at the French Great Northern Railway Station, a French scientific periodical says: "Better to have a wise enemy than an imprudent friend."

—— CAPT. F. V. GREENE, United States Engineer Corps, has been instructed by the commissioners to visit New York, Philadelphia and Boston, and examine the devices used in those cities for underground electric light, telephone, and telegraph wires, with a view to decide upon the proper course to be pursued by the local authorities.

—— A COMMEMORATIVE STONE has been placed on the house, No. 17, in Via Dei Prefetti, Rome, to Morse, the telegraphist. The inscription is as follows, translated into English:—"Samuel Finkez Breese Morse inhabited this house from 20th February, 1830, to January, 1831. inventor of the writing electro-magnetic telegraph. He was born at Charlestown, 27th April, 1791; died at New York 2d April, 1872."

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—— MAYOR HARRISON, of Chicago, is engaged in a war upon telegraph poles, which have been prohibited by the city council within the corporation limits. By his recent order, the Mutual Union, Board of Trade, and Chicago and Milwaukee wires were cut near the city limits. The time in which the Mutual Union could maintain poles in the city expired on March 1. The Western Union limitation will be reached about two months hence.

—— A BUILDING for the Western Union Telegraph Co , in course of erection at Buffalo, has supports for 1,100 wires upon the roof. To carry these wires into the various rooms of the building, 150,000 holes will have to be bored three-eighths of an inch in diameter, and most of them through wood four inches thick. This is equal to one continuous hole 600,000 inches, or over nine miles long. A separate job for boring this nine mile hole has been let.

—— MR. J. N. GEORGE, of the late firm of Stearns & George, electricians, and also, formerly manager of the Telephone Despatch Co., has lately established an agency for the introduction of the Fuller Electrical Co.'s light into the States of Maine and New Hampshire, his headquarters being at No. 37 Pearl Street, Boston. Mr George brings to his new work a thorough and practical knowledge of electricity—the result of a long business experience in this field of science.

—— SOME ENGLISH UNDERGRADUATES who had been in labor with a new practical joke, at length brought it forth and christened it the telegraph joke. At half hour intervals, throughout the night, they telegraphed to a friend in Jersey, asking after his health and how he liked existence in Jersey. This was, no doubt, very amusing to the jokers, but the luckless "jokee" did not enjoy it all; for his father, who couldn't get a wink of sleep, disinherited him on the spot, declaring that only a bad son would have such a pack of fools for his friends.

—— AMONG THE TELEPHONE stories floating about, is the following: An old man would not believe he could hear his wife talk a distance of five miles by telephone. His better half was in a country store several miles away, where there was a telephone, and the skeptic was also in a place where there was a similar instrument, and on being told how to operate it, he walked boldly up and shouted: "Hello, Sarah!" At that instant lightning struck the telephone wire and knocked the man down, and as he scrambled to his feet, he excitedly cried, "That's Sarah, every time!"

—— A GENTLEMAN in Danielsonville, Connecticut, whose favorite dog enjoys following his carriage, by accident left the animal some miles from home. The people recognizing the dog, shut him in the house over night. The next morning a voice asked, through the telephone: "Have you lost a dog?" "Yes; where is he?" Voice: "Call him." He did so. The telephone was put near the dog, when he recognized his master's voice, and, in his dog way, manifested joy, licking the instrument and jumping about, eager to answer the call.

—— THE *Chicago Times* says, that a remarkable electrical phenomenon manifested itself, on the line of the Union Pacific Railway, recently, between North Platte and Sidney, Neb. The influence, however, was felt perceptibly beyond those points. The rails were surcharged with a current of electricity, moving from west to east to so high a degree that hand cars standing on the track were impelled at a fair rate of speed by it. One hand car at Brule got away from the section men next east. The influence of the current was felt by many persons along the track, and no little excitement prevailed during its continuance.

—— AN INCANDESCENT LAMP was recently made which contained an imperfection, which consisted of a small copper wire connecting the two poles When the lamp was put in use, this copper was volatilized and condensed, on the interior of the glass globe Ordinarily it appears to be a highly burnished copper knob, worthy of a place at the head of a drum-major's baton, but, on placing the lamp before a strong light, the copper is so thin, that objects can be distinguished beyond the lamp; in this manner the copper appears of a greenish hue. This deposit is noticeably thinner in the plane of the carbon filament, the lines are so sharply defined as to resemble a shadow.

—— A PENNSYLVANIA COURT has decided that the transfer of the credits and debits of accounts by telephone is as valid as that by word of mouth, in which there is no actual evidence in writing of the transaction.

—— WHEN THE EMPEROR WILLIAM'S brother died the sudden cessation of all court festivities had a seriously ill effect upon the health of His Majesty, as he requires constant pleasurable excitement to counteract the strain of state duties. The court doctors and other attendants were driven to their wits' end to find some amusement for him that would be in accordance with etiquette. At last they hit upon the idea of getting up a series of scientific lectures The first discourse was by Dr. Werner Siemens, on the electric elevated railroad, which he intends to build in Berlin. The Emperor and his family attended, and showed great interest in the lecture, and the end aimed at by the doctors was thus fully reached.

—— A WASHINGTON despatch to the *Post*, March 22d, states: R. G. Dun, President of the Overland Telephone Company, is here. He says the company are at present only experimenting, but so far the experiments have been satisfactory. Every test imaginable has been applied, and the company, as well as electricians, are highly gratified with the result. Mr. Dun said that the company do not intend to build lines of their own, but will hire the privilege of using their invention and the instruments to telegraph companies. He says that one of the wires of the Baltimore and Ohio Company has been secured to test further the invention between this city and New York, and within a few days, probably this week, the two cities will be in telephonic communication,

Myron L. Baxter, the inventor, was found at his desk in the Surgeon-General's office. He says that he has not yet finished the experiments of long distance talking, but he has a wire running from his laboratory for a distance of five miles, and he says that over this wire he can hear a whisper spoken at a distance of seventeen feet from the transmitter. The great difference between the Blake transmitter and his invention, Mr. Baxter says, lies in the fact, that while there is no doubt that the Blake instrument could be so adjusted as to admit of a whisper, spoken several feet distant, being heard over the entire line, if the speaker change his voice to a shout it would so agitate the diaphragm that nothing could be heard. With the Baxter transmitter, on the other hand, the tone of voice would not make any difference at the other end. Mr. Baxter says that he has experimented with electricity for twenty-five years.

—— THE LONDON *Electrician* gives the following information with reference to the electric exhibition which it is proposed to hold in Vienna, this year It appears that his Imperial Highness the Crown Prince Archduke Rudolph, of Austria, has consented to become a patron of the exhibition, and takes great interest in it. His Majesty the Emperor, has, through Prince Hohenlohe, given an order to Carl Giani, for the production of a very handsome pavilion to be shown at the exhibition. It is intended to drape the interior of this pavilion with rich hangings and embroideries, and to light it up by means of different systems of electric lighting, so as to show the adaptability of the electric light for the purpose, and also to afford a means of comparison between various systems. The extent which the exhibition is likely to reach, may be estimated by the fact, that the motive power which will be required, has been fixed at 1,000 h.p. About 700 h.p. is intended to serve for lighting the exhibition buildings and grounds. The boilers and engines employed will, in the majority of cases, be of the fixed type, although portable boilers and engines will not be excluded. All boilers and engines of whatever type, will be objects of exhibition. It has been proposed to arrange the boilers and steam engines as they would be if erected for permanent work, and so that they may be easily inspected by visitors. The machinery department will thus offer a good opportunity to engineers of making valuable comparisons. Although such an arrangement will considerably add to the expenses, nevertheless, the commission has consented to sacrifice a greater amount of money in order to secure an opportunity of general instruction, and thus hasten the solution of the important question—how to construct boilers and engines for electric lighting purposes.

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—— A LONDON COTEMPORARY says: M. Shulachenko, who managed the Russian military telegraph during the Kulja expedition, communicates to the Russian Physical Society, the following results of his experiments with Siemens' telephones:—At a distance of 93 miles, music, singing and speaking were heard quite distinctly; at 130 miles, conversation was difficult—it was necessary to shout loudly, and those who received messages had to display a great sensibility of ear; but it was possible to have conversation even at a distance of 212 miles. When six pairs of telephones were put side by side, having each its wire, and the wires not being connected with one another, the conversation on one of them was heard on all the others. When the connecting wire of one pair of telephones was broken, the conversation on this pair was heard on the next pair of telephones, the wire of which was in good state.

—— INDUCTION COILS, Portable Batteries, and Electric Lights, was the subject of a recent paper read by Mr Charles J. Clark, before the Glasgow Philosophical Society The London *Electrician* says, that he began by describing an apparatus he had invented for lighting gas by means of electricity. He then proceeded to show how, in the course of his investigations, he had discovered that by the use of iron wire interlaid with cotton, he had succeeded in producing a perfect induction coil, greatly less in size and at little more than half the cost of the coil formerly in use He next showed how by using a similar coil, a small portable battery had been constructed, which could be utilized for many practical purposes, as, for example, in the ringing of bells, or the production of lights from small incandescent lamps. In illustration of the latter use, a gentleman, by whom the author of the paper was accompanied showed, an electric light burning, in his scarf pin, the electricity being supplied from a small battery carried in his waistcoat pocket. At the close of the paper, Sir William Thomson paid a high compliment to Mr. Clark for the industry and perseverance he had shown in perfecting his valuable inventions. The improvements he had made in portable batteries were of the greatest importance. He himself had been experimenting for years in the same direction with exceedingly little result, and he had often wished for a small portable battery such as he now saw realized. Setting aside such applications of the incandescent lamp as the placing of it in a gentleman's shirt pin, or in the hair and dresses of ladies for the amusement of the public, as by the fairies in *Iolanthe*, Mr. Clark had shown how it could be turned to important practical uses. A railway traveler might, for example, have a lamp which would burn for an hour, which was as long as any one should read in such circumstances, and it would also be useful during the night or in the sick room, rendering unnecessary the objectionable practice of keeping gas on the peep, or of striking lucifer matches. In reply to a question, Mr. Clark said he understood that some explosions had taken place with the gas lighter, at the works of Mr. Crum. of Thornliebank. He had since, however, made such modifications in the apparatus as would render explosions in future impossible. Mr. Thomas Gray next read a paper on a new seismographic apparatus, to be used at Tokio, Japan, in recording the time of occurrence of, and the horizontal and vertical motion during an earthquake.

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BOOK NOTICES.

MESSRS. BURKE, FRASER & CONNETT'S *Quarterly Circular* of information and advice about patents and inventions for March, published for the free use of their clients, contains valuable articles on "Patents in Germany"; "Value of Germany as a Field for Invention"; "Governmental Policy in Patent Law"; "Bad Policy of Imposing High Fees on Inventors"; "How Patents Should be Granted"; "Ignorance of Newspaper Writers About Patents," &c., &c, See advertisement in another column.

RECUEIL DE QUELQUES MEMOIRES, by Dr. Donato Tommasi. These papers were published in *Cosmos-les Mondes*, and refer for the most part to the chemical action of electricity. "Relation between the electro-motive power of the pile, and the calorics of water decomposition" and some short remarks on the electrolysis of water by carbon electrodes, form suggestive contributions to the great and, as yet, almost unexplored field of electro-chemical science. Dr. Tommasi, who is a most distinguished chemist, has written extensively on this and kindred subjects, and there would seem good reasons for believing that much that is now involved in mystery, both in chemistry and electricity, may be explained from such experiments. That there are great possibilities in this direction hardly admits of a doubt—in fact, our working electricity is now generally furnished by chemical action.

FROM the new edition of Messrs. Geo. P. Rowell & Co.'s AMERICAN NEWSPAPER DIRECTORY, which is now in press, it appears that the newspapers and periodicals of all kinds issued in the United States and Territories now reach the imposing total of 11,196. This is an increase of 585 in twelve months Taking the States one by one, the newspaper growth in some is very considerable. The present total in New York State, for instance, is 1,399—a gain of 80 in the past year. The increase in Pennsylvania is 48. the existing number being 943. Nebraska's total grew from 175 to 201, and Illinois' from 890 to 904. A year ago Massachusetts had 420 papers; now the number is 438. In Texas the new papers outnumbered the suspensions by 8, and Ohio now has 738 papers instead of 692. The most remarkable change has occurred in the Territories, in which the daily papers have grown from 43 to 63, and the weeklies from 169 to 243—Dakota being the chief area of activity. The number of monthlies throughout the country grew from 976 to 1,034, while the dailies leaped from 996 to 1,062. The figures given above are exclusive of Canada, which possesses a total of 606. It is interesting to note that the newly settled regions of the Canadian North-West are productive of newspapers as well as of wheat, for the number of journals issued in Manitoba was nearly doubled during the year.

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PATENTS FOR FEBRUARY AND MARCH, 1883.

FEBRUARY 20th.

272,811 Electric-arc Light. J. A Wetmore, Concord, Mich.
272,441 Electric Underground Conductor. R. M. Hunter, Philadelphia, Pa.
272,833 Electric Wires, System of Laying Subterranean Lines of. J. T. Goodfellow, Philadelphia, Pa.
272,792 Electrical Currents, Metallic Circuit for. S. D. Strohm, Philadelphia, Pa.
272,799 Electro-magnetic Regulator. R. H. Tucker, East Orange, N. J.
272,659 Insulated Electric Conductor. A. A. Cowles, New York, N. Y.
272,660 Insulated Electric Conductor. A. A. Cowles, New York, N. Y.
272,464 Railway Signal, Electric. E. L. Orcutt, Somerville, Mass.
272,839 Railway Signal and Switch System; Electric Interlocking. J. K. Knight. New York, N. Y.; and W. H. Baker, Brooklyn, N. Y.
272,724 Ships and the Rate of Currents, Electric Log or Apparatus for Ascertaining the Speed of. R. M. Lowne, East End, Finchley, County of Middlesex, England.
272,774 Telegraph Cable. N. M. Rittenhouse, Baltimore, Md.
272,524 Telegraph Wire Coupling. G. Brott, Waterford, N. Y.
272,645 Telegraphs, Signaling Apparatus for District and Fire Alarm. T. A. Casey, New York, N. Y.
272,505 Telephone Exchanges, Alarm Signal Apparatus for. E. A. Wolk, Springfield, Mo.

MARCH 6th.

273,565 Car Brake, Electric. D. J. Macpherson, Sioux Falls, Dakota.
273,634 Clock, Electric. D. F Sweet, Hastings, Mich.
273,622 Door Opener, Electrical. A. T. Smith, New York, N. Y.
273,291 Electric Force, Apparatus for Regulating the Transmission of. M. Levy, Paris, France.
273,487 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
273,488 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
273,406 Electric Machines, Air Blast Attachment for Commutators of Dynamo. E. Thomson, New Britain, Conn.
273,259 Electric Wires, Binding Screw for. E. C. Coolidge, Boston, Mass.
273,305 Electric Wires, Underground Conduit for. W. Plankinton, Milwaukee, Wis.
273,429 Electrical Conductor Coupling. P. R. Allen, Southwark County of Surrey, England.
273,493 Electrical Generator Engines, Valve Gear for. T. A. Edison, Menlo Park, N. J.
273,4 1 Electrical Generators, Regulator for Driving Engines of. T. A. Edison, Menlo Park, N. J.
273,329 Electrical Transmission of Power, Controlling the. E. Weston, Newark, N. J.
273,598 Electrode for Secondary Batteries. W. S. Platt, Waterbury, Conn.
273,593 Insulated Electrical Conductor. W. R. Patterson, Chicago, Ill.
273,592 Insulating Substances, Filling Telegraph Cables with. W. R. Patterson, Chicago, Ill.
273,336 Lamp, Electric-arc. G. D. Allen, Brooklyn, N. Y.
273,554 Lamp, Incandescent Electric. H. Lea, Birmingham, County of Warwick, England.
273,485 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
273,486 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
273,366 Lamp, Incandescing Electric. J. S. Kelso, Jr., Stamford, Conn.
273,494 Railway, Electrical. T. A. Edison, Menlo Park, N. J.
273,377 Railway Signal, Electric. C. J. Means, Boston, Mass.
273,490 Railway System, Electro-magnetic. T. A. Edison, Menlo Park, N. J.
273,489 Railway Turn-table, Electric. T. A. Edison, Menlo Park, N. J.
273,492 Secondary Battery. T. A. Edison, Menlo Park, N. J.
273,374 Telegraph, Fire and District. T. D. Lockwood, Malden, Mass.
273,204 Telegraph Sounder. W. E. Davis, Jersey City, N. J.
273,563 Visual Indicator, Electrical. J. W. Mackenzie, New York, N. Y.

MARCH 13th.

274,023 Car Brake, Electro-magnetic. H. S. Park, Henderson, Ky.
273,739 Electric Battery. P. Jablochkoff, Paris, France.
274,074 Electric Testing Apparatus. C. J. H. Woodbury, Lynn, Mass.
273,859 Electrical Conductors, Junction Box and Connection for. J. Kruesi, Brooklyn, N. Y.
273,823 Electrical Distribution, System of Underground Conductors for. T. A. Edison, Menlo Park, N. J.
273,897 Fence and Telegraph Post, Iron. L. Petrequin, Detroit, Mich.
273,751 Galvanic Battery. L. D. McIntosh, Chicago, Ill.
273,888 Lamp, Electric-arc. L. Piette and F. Krizik, Pilsen, Austria-Hungary.
273,704 Lamp, Incandescent Electric. A. Bernstein, Boston, Mass.
273,714 Magneto-electric Signaling Apparatus. T. A. Edison, Menlo Park, N. J.
274,082 Secondary Battery. C. F. Brush, Cleveland, Ohio.
273,855 Secondary Battery. N. S. Keith, New York, N. Y.
273,810 Telegraph Printing. W. J. Burnside, Hilcot Court Road, Lower Norwood, County of Surrey, England.
273,728 Telegraphic Receiving Instrument. E. M. Hamilton, New York, N. Y.
274,075 Telephone Transmitter. R. D. Woodworth, Orange, N. J.

MARCH 20th.

274,395 Clock, Electric. V. Himmer, New York, N. Y.
274,445 Clock Escapement, Electric, A. W. Gray, New York, N. Y.
274,393 Clocks, Circuit Controller for Electric. V. Himmer, New York, N. Y.
274,394 Clocks, Circuit Controller for Electric. V. Himmer, New York, N. Y.
274,371 Electric Current Regulator. C. G. Perkins, Camden, N. J.
274,150 Electric Currents, Cut-out for Dangerous. F. A. Swan, and C. B. Bosworth, Boston, Mass.
274,151 Electric Cut-out. F. A. Swan, and C. B. Bosworth, Boston, Mass.
274,101 Electric Motor. J. B. Atwater, Chicago, Ill.
274,213 Electrical Conductors, Underground Conduit for. H. R. Meyer, Liverpool, County of Lancaster, England.
274,290 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
274,452 Galvanic Batteries, Circle Switch for. H. Lowe, Brooklyn, N. Y.
274,110 Galvanic Battery. F. De Lalande, Paris, France; and G. Chaperon, Mines, D'Aloeno, Spain.
274,181 Gas for Electric Lights, Apparatus for Substituting. P. B. Delany, New York, N. Y.
274,396 Incandescents, Manufacture of. T. A. Edison, Menlo Park, N. J.
274,297 Lamp Cut-out, Electric J. H. Elfering, Chicago, Ill.
274,298 Lamp, Electric. T. A. Edison, Menlo Park, N. J.
274,370 Lamp, Electric-arc. C. G. Perkins, Camden, N. J.
274,413 Lamp, Electric-arc. E. Thomson, New Britain, Conn.
274,497 Lamp Holder, Incandescent. E. Weston, Newark, N. J.
274,295 Lamp, Incandescent Electric. T. A. Edison, Menlo Park, N. J.
274,294 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
274,212 Telegraph and Semaphone Signal. W. W. McLellan, Newcastle, New Brunswick, Canada.
274,112 Telegraph Apparatus. G. D'Infreville, New York, N. Y.
274,300 Telegraph Printing. S. D. Field, New York, N. Y.
274,416 Telegraph Printing. H. Van Hoevenbergh, Elizabeth, N. J.
274,417 Telegraphy, Dynamo. H. Van Hoevenbergh, Elizabeth, N. J.
274,352 Telephone, Receiving. J. A. Maloney, Washington, D. C.
274,353 Telephone Transmitter, Electric. J. A. Maloney, Washington, D. C.
274,246 Telephonic Transmitter. C. Ader, Paris, France.

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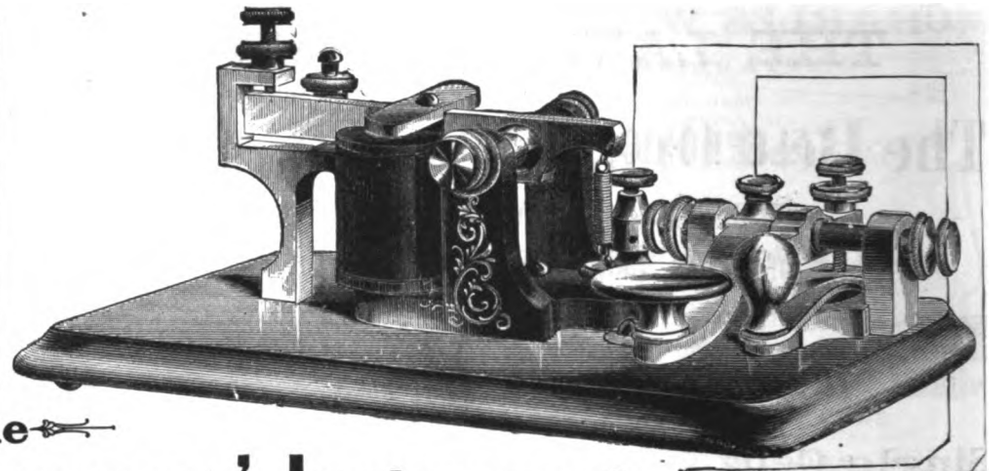

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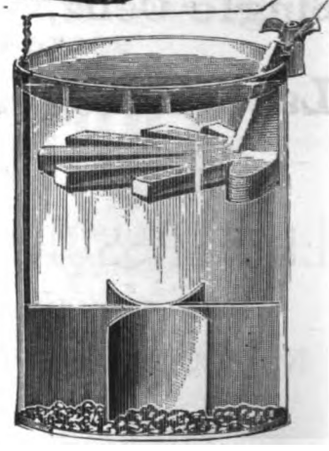

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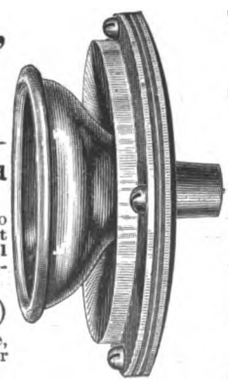

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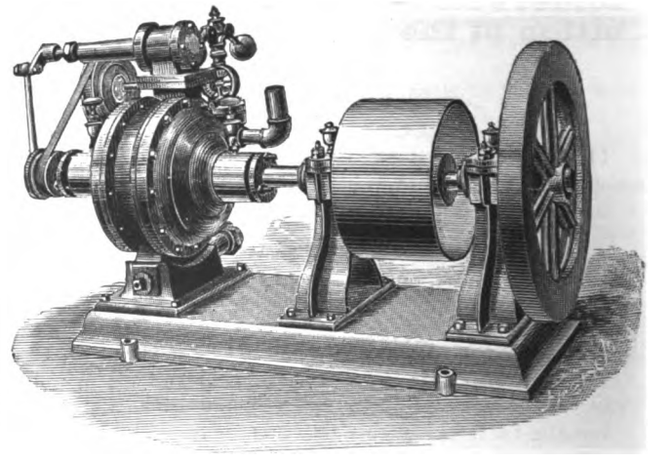

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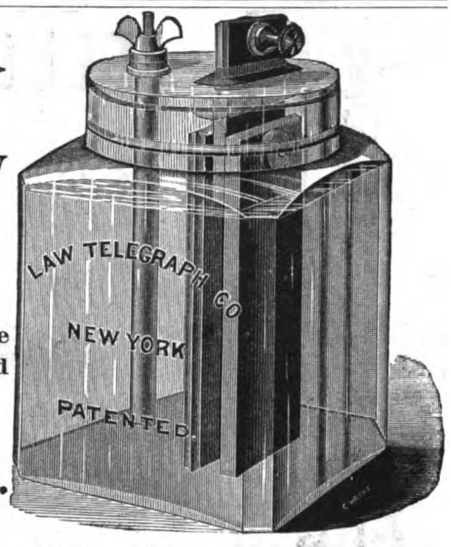

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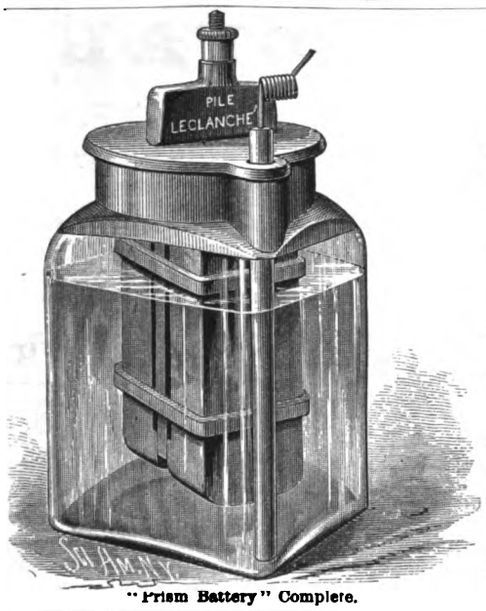

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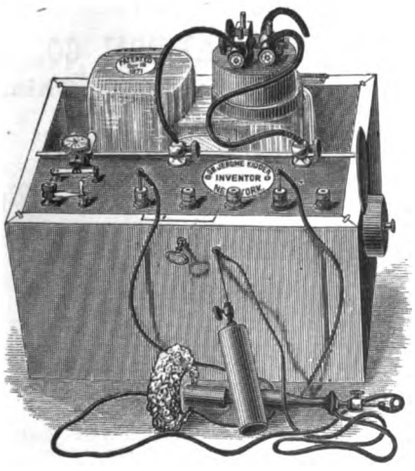

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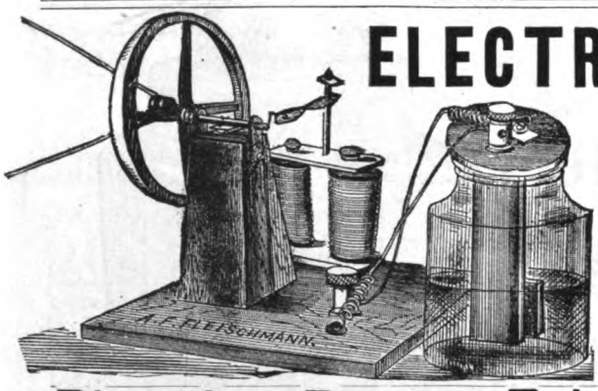

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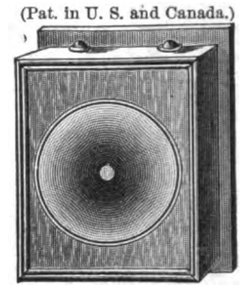

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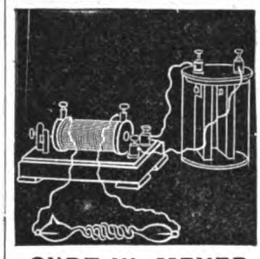

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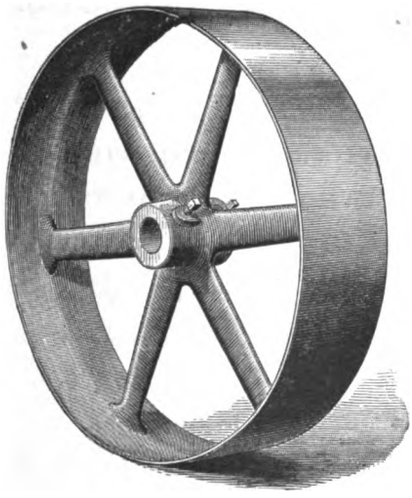

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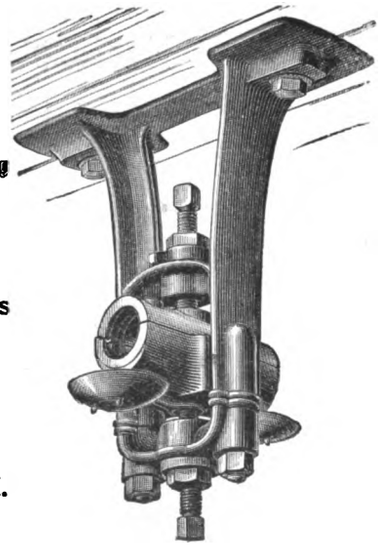

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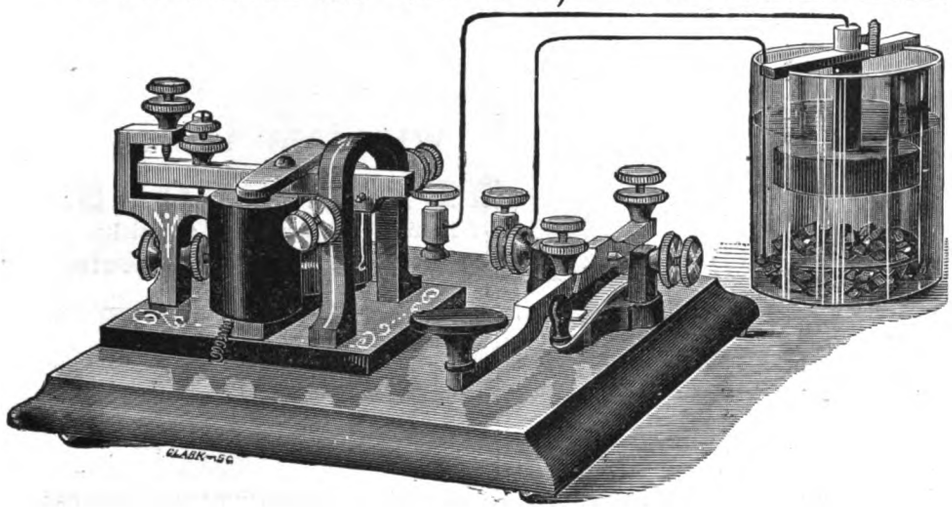

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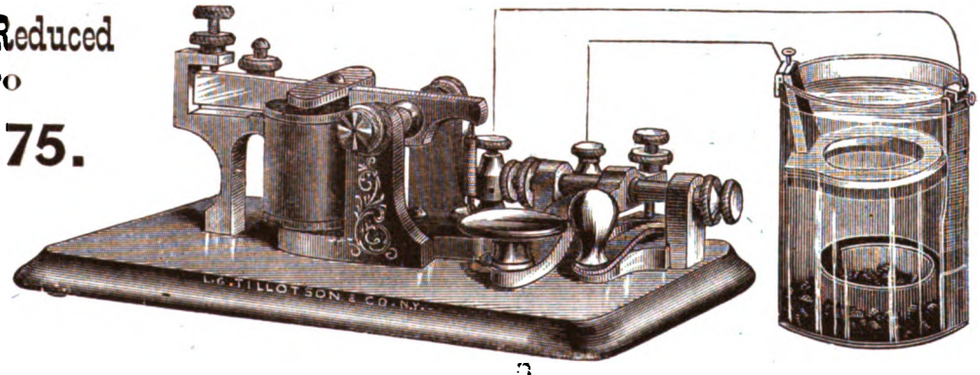

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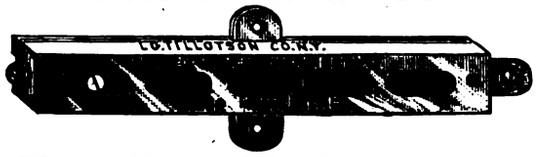

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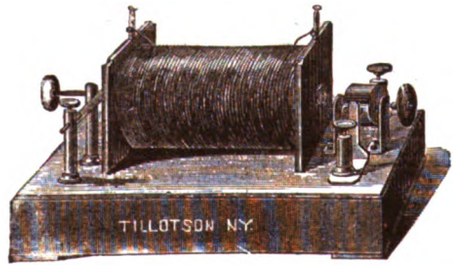

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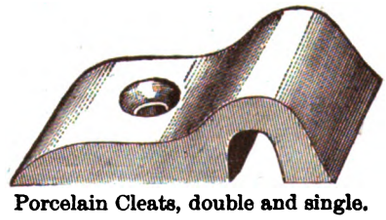

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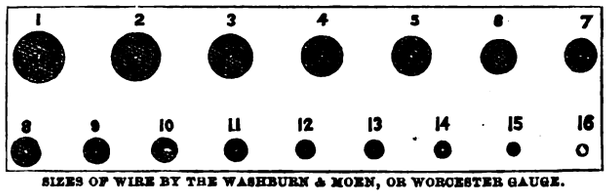

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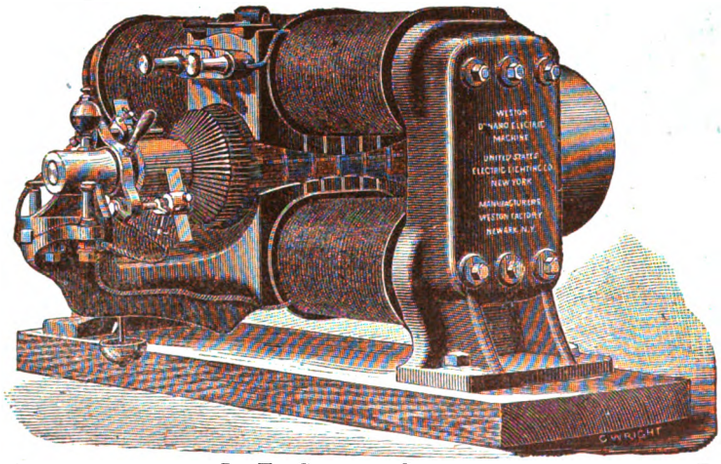

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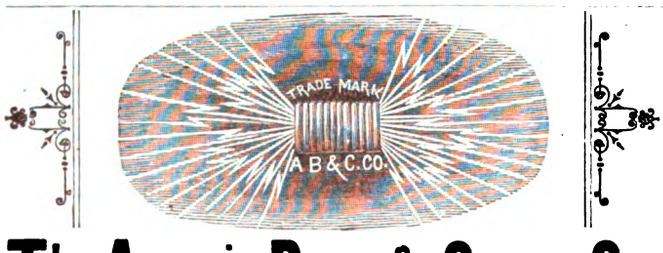

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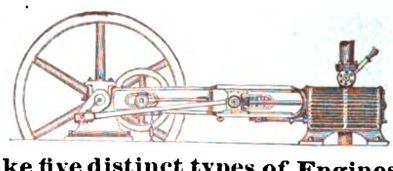

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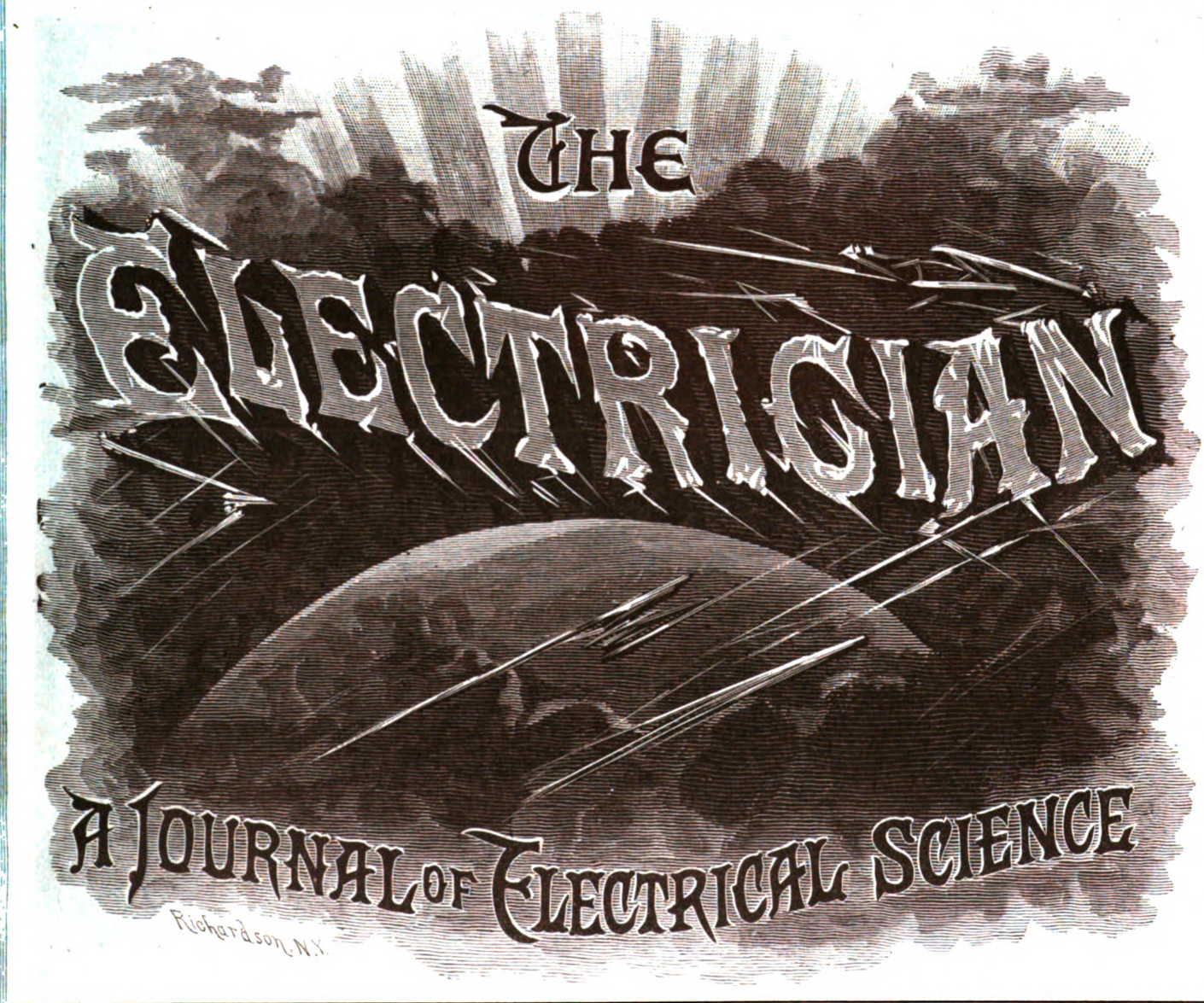

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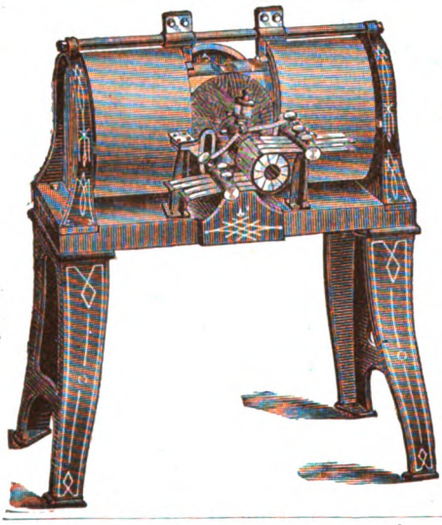

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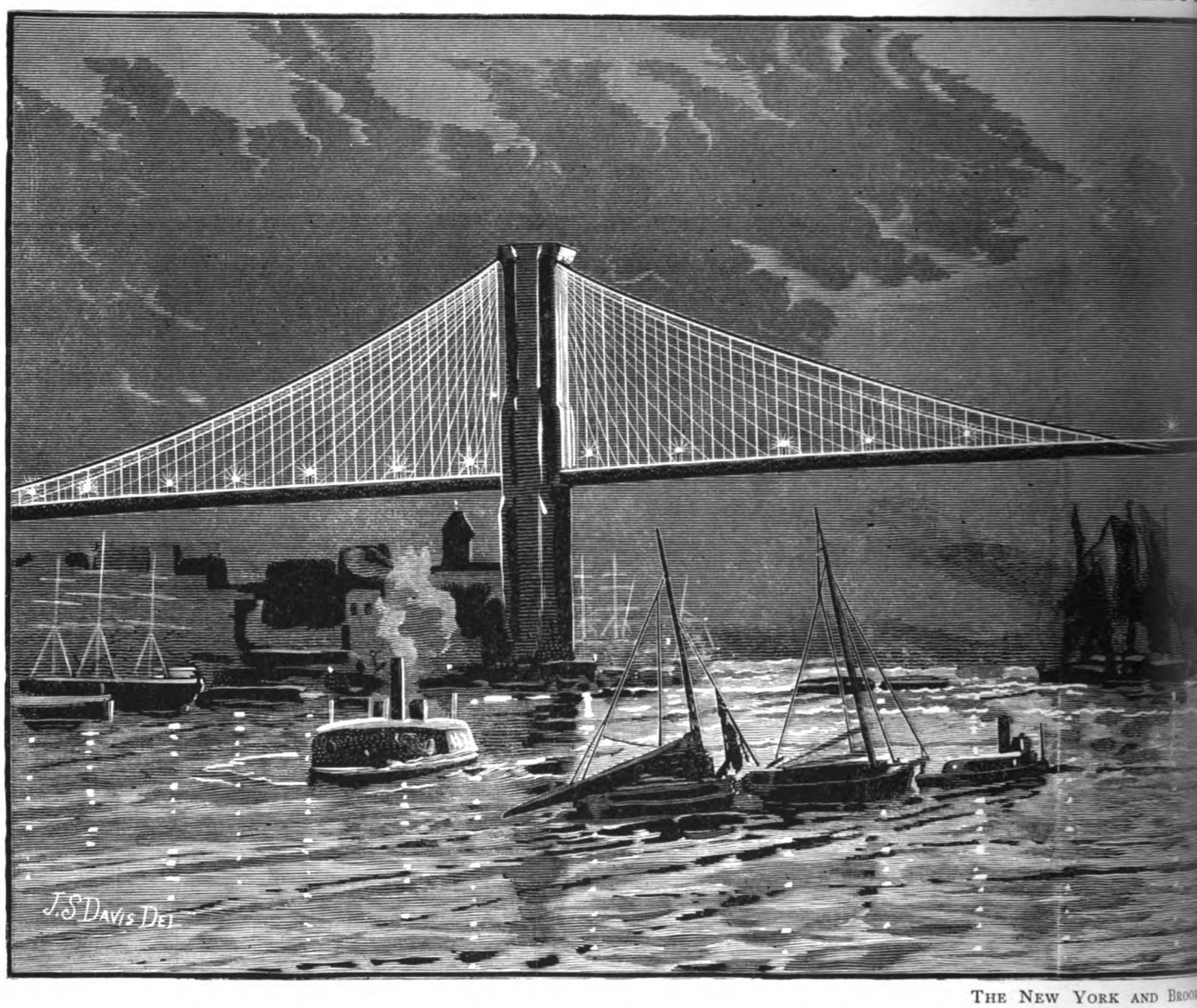

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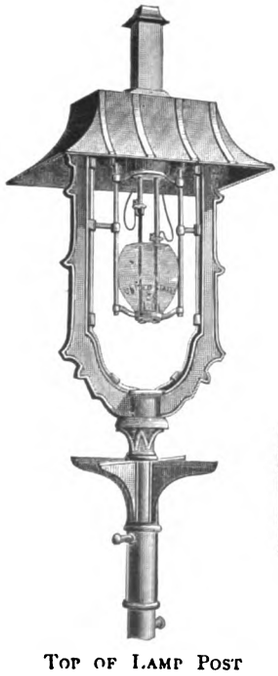
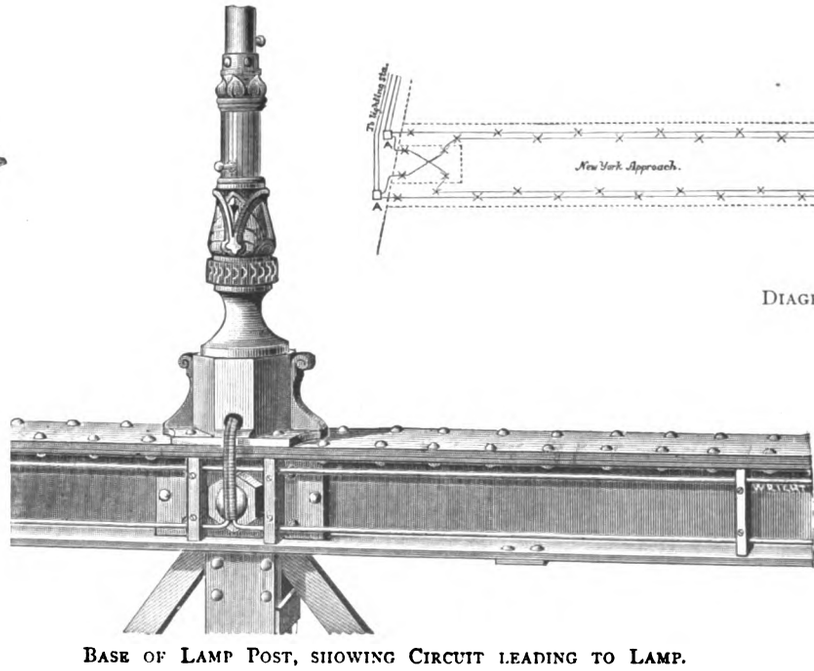


TOP OF LAMP POST



BASE OF LAMP POST, SHOWING CIRCUIT LEADING TO LAMP.

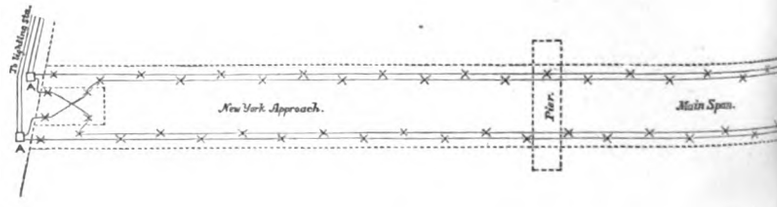


DIAGRAM SHOWING ARRANGEMENT OF CIR

SECTION

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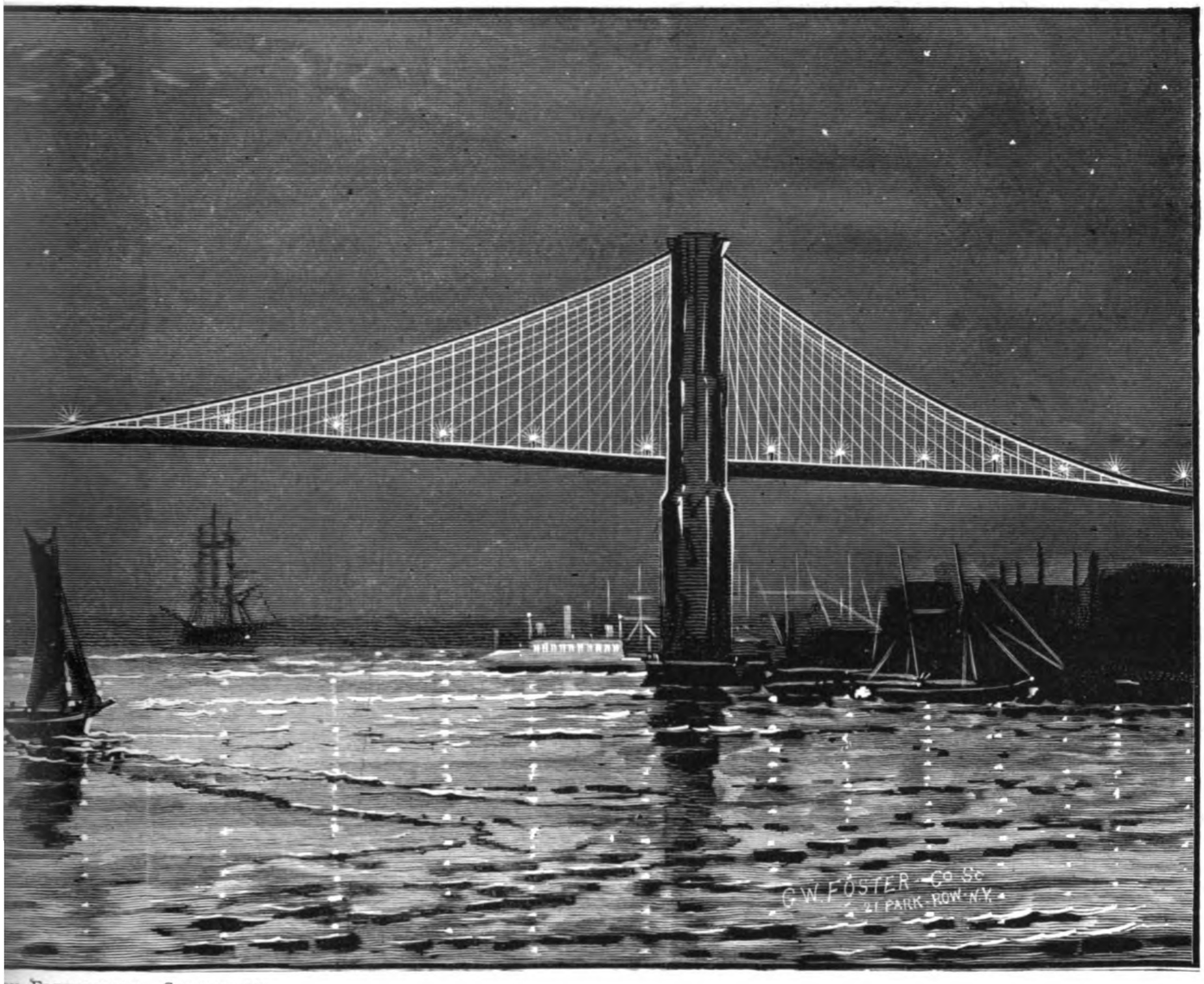
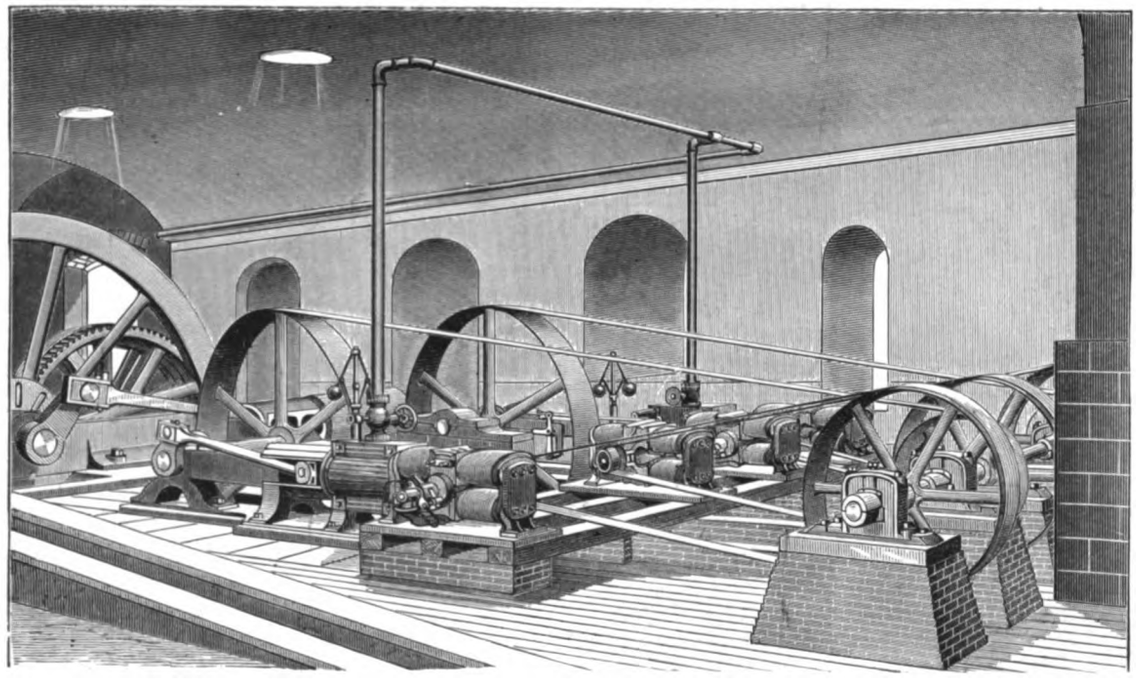


BY ELECTRICITY —See page 159.



ENGINE ROOM NEAR BROOKLYN PIER, SHOWING WESTON DYNAMOS AND DRIVING ENGINES.

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THE ELECTRICIAN.

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ELECTRIC LIGHT ON THE BROOKLYN BRIDGE.

THE most noteworthy of the recent electric light installations is the plant erected by the United States Illuminating Company, of this city, for lighting the Brooklyn Bridge and its approaches. The intense interest of the public in everything connected with the great bridge, and the very conspicuous position in which the lights are placed, will probably attract more attention to this plant than to any other which has been put in operation for a long time.

It is a striking commentary on the progress made in electric lighting, that when the bridge was commenced no one would have thought of lighting it by electricity when completed, except as a remote possibility not worthy of serious consideration, but when the time came for awarding the contract no other light was seriously considered. As will be remembered this contract was the subject of extremely spirited competition between all the principal electric light companies, and was finally awarded by a committee of the board of trustees, after an unusually careful investigation of the whole subject. The following extract from the official report of the committee is of interest, as giving the principal considerations by which the committee was influenced in making its decision.

"The proposal of the Edison Company involved the use of incandescent lights, and was not favorably considered, as it appeared to the committee that greater economy of power and more perfect general illumination could be obtained, in lighting large spaces, such as the roadways of the bridge, by the use of powerful arc lights.

"Of the different arc systems represented, the Weston system, used by the United States Company, and the Brush system, used by the Brush Swan Company, seem to present greater advantages than the others. Both of these systems are well-known and have for a long time been in successful and very extensive use throughout the country, and the companies which are introducing them are doing a large business and have had great experience in carrying out installations similar to that desired for the bridge.

"While there seems to be little room for choice between the two systems in regard to reliability of the apparatus for continuous use, the Weston system appears, from the facts presented to the committee, superior to the Brush in other respects, and especially in economy of power, and in safety.

"The engineers of the bridge have carefully examined the Weston apparatus, and are of the opinion that it is admirably designed and well-constructed, and the large number of lights of this system which they have observed in operation in New York city appear to be working in a very satisfactory manner.

"It appears that tests and measurements which have been made of different dynamo machines, with reference to economy of power, and especially those conducted by the committee, appointed for that purpose, at the Paris Electrical Exposition, show a considerably higher efficiency for the Weston dynamo than for the Brush, or for any of the others which have been brought into competition with it; and it is stated by the representatives of the United States Company that important improvements have been made in the Weston machine since these tests were made, which makes its superiority in this respect still greater.

"As the expense of supplying power to operate the lights is to be borne by the bridge corporation, and will be continuous, any considerable reduction in the amount of power required appears to be a very material consideration.

"In view of the numerous reports of fatal accidents occasioned by persons coming accidentally into contact with the wires of electric lighting circuits in which a current of very high tension is employed, the committee inquired very carefully into the relative safety of the different systems submitted, and, from the facts elicited, is convinced that the advantages of the Weston system in this respect are very marked. The Weston lamp is constructed to work with a very short arc or separation between the carbon points (the length of the Weston arc being about $\frac{1}{32}$ of an inch, while the arc employed in the other systems is from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in length), and the tension of the current required for working a given number of lamps in the same circuit in the Weston system is correspondingly low. The Weston current is also continuous and uniform, while in some of the other systems—notably in the Brush—the current is pulsating in its character; and all writers on the subject appear to agree that a pulsating current is much more dangerous than a continuous one of the same tension.

"As the bridge is to constitute a great public thoroughfare, and any defect of insulation or accidental displacement of the wires might bring the iron work of the structure into the circuit, it seemed to the committee in the highest degree objectionable to permit the use of such a current as would be capable of doing deadly harm. A current of very high tension, especially when it is pulsating in its character, appears to be capable of producing injurious, and even fatal shocks, while with a continuous-current of comparatively low tension, such as is used in the Weston system, such danger is not to be apprehended."

Judging from the character of the work done, the decision of the committee, in awarding the contract to the United States Company, seems to be fully justified, as all the details of the installation have been carried out in the most careful manner, and the results obtained are extremely satisfactory.

Our illustrations give a good idea of the general effect produced by the lights, and some of the more interesting details of the plant.

There are in all, seventy arc lamps of the Weston double carbon type, arranged in two circuits of thirty-five lamps each. Of these, fourteen are placed on the main span, fifty on the approaches, and the remainder in the stations at each end, and in the engine house. The two circuits are entirely independent of each other, and are so arranged as to take in alternate lamps entirely around the bridge. This is well shown in the diagram of circuits given in the cuts. As the bridge, with its approaches, is more than a mile in length, the two circuits comprise more than four miles of line wire. Each circuit is worked by two twenty-light Weston dynamos, coupled in tension, and driven by an independent Corliss engine, of the Watts-Campbell type. Considerable margin

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has been provided both in dynamos and steam plant, in view of a probable increase in the number of lights. The dynamos and engines are placed in the main engine house, on the Brooklyn side, and arranged as shown in the cut.

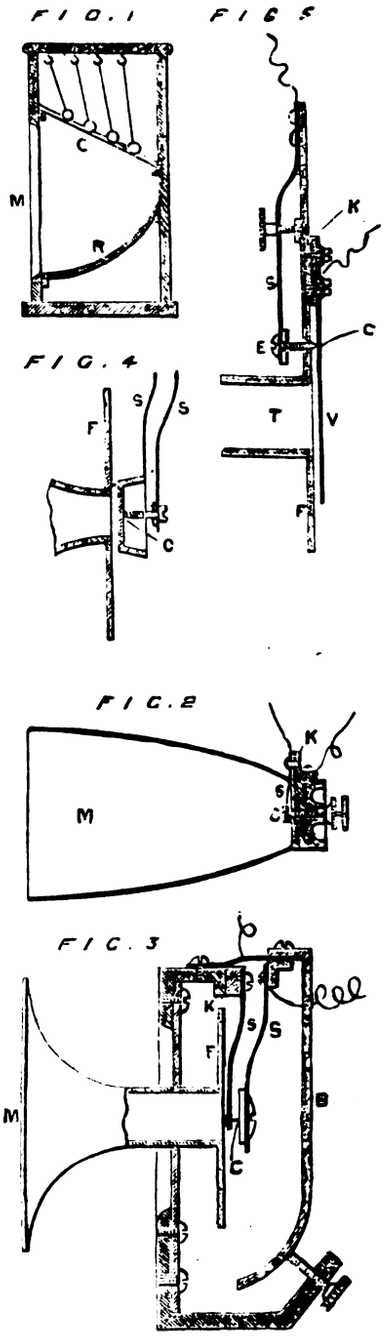
As the structure of the bridge is mainly of iron, unusual difficulties have been encountered in regard to insulation; but these have been surmounted in a very satisfactory manner, and the arrangement and erection of the circuits is especially to be commended. The wire used for the mains is insulated by a thick coating of kerite, wound with kerite tape, and the whole enclosed in a stout sheathing of braided cotton. For the main part of the bridge and approaches, the wires are carried along on the face of the trusses, over the railway tracks, and secured at intervals of a few feet by passing through cleats of wood boiled in paraffine, which are bolted to the iron work. Where the wires pass around the buttresses at the ends of the approaches, or are brought within reach of either the foot walk or drive way, they are brought together, wrapped with a thick covering of kerite tape and enclosed in an iron gas pipe. The wires which are alongside of each other are of different circuits, the out and return wires of each circuit being on opposite sides of the bridge. The lamp posts are mounted on the top of the trusses and the wires are taken off inside of the posts to the lamps, as shown in the cuts.

As the alternate lamps are entirely independent of each other, in regard both to circuits, and to dynamos and engines, the chance of any accidental stoppage of all the lights seems very remote; but in order to provide every possible safeguard, arrangements have been made for connecting the bridge circuits with the lighting stations of the U. S. Illuminating Co. in New York whenever desired. For this purpose mains have been run from the stations to the New York end of the bridge, and connected with cut-off boxes in the bridge circuits, and similar cut-off boxes have been placed in the engine house on the Brooklyn side. These are shown at A A in our diagram. By closing the switches on the Brooklyn side, and opening those on the New York side, the bridge circuits are interposed as loops in the lines from the stations.

The engines are to be supplied with steam from the main boilers, used for operating the railway on the bridge, and as these are not yet in place, the lights are run for the present from the Illuminating Company's station on Elm Street.

PROF. S. P. THOMPSON'S NEW TELEPHONES.

THE telephonic apparatus recently patented by Prof. S. P. Thompson, of University College, Bristol, is so simple and in many respects so suggestive, that it may be useful, as it certainly will be interesting, if we illustrate some of the forms devised by him. The improvements relate to telephonic transmitters based upon the principle discovered by Philipp Reis in 1861, namely, that of employing current-regulators actuated, either directly or indirectly, by the sound waves produced by the voice. By the term current-regulator is meant a device similar to that employed by Reis, wherein a loose contact between two parts of a circuit (in which are included a battery and a telephonic receiver) offers greater or less resistance to the flow of the electric current, the degree of intimacy of contact between the conducting pieces being altered by the vibrations of the voice. In Reis's transmitter, and in Edison's transmitter, and other well-known forms of these instruments, the action is indirect, a tympanum of stretched membrane or other equivalent organ, such as a diaphragm of mica, being used to collect or magnify, or concentrate the vibrations of the voice, and to convey them to the point or points of loose contact that regulate the current. In other forms of transmitters (for example, some of Hughes's microphones), the mode of action is direct, the air waves beating directly upon the conductors or electrodes which are in loose contact, without the



intermediation of a tympanum or diaphragm. Of these two classes of telephone transmitters, viz :—those in which the current-regulator is combined with a tympanum or diaphragm, and those in which the current-regulator is acted upon directly by the air waves of the voice, the improvements relate to the latter only, as Prof. Thompson dispenses with the membrane tympanum used in Reis's transmitter; and does not employ the tympanic diaphragm of mica used in Edison's transmitter; he does

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not even employ any diaphragm in the sense of a partition between the current-regulator and the air waves of the voice, as in Theiler's transmitter. In the improved transmitters, the air waves act directly upon the current-regulator itself. As a result, the articulation is clearer for some of the consonantal sounds, which are only imperfectly or difficultly transmitted by telephones in which the current-regulator is affected indirectly through a tympanum, diaphragm or partition. Transmitters of the class to which the improvements relate are, ordinarily, liable to two defects. Firstly, they do not articulate so loudly as transmitters in which there is a tympanum or diaphragm to collect or magnify the vibrations. Secondly, when, to obviate this difficulty, the speaker speaks with his mouth very close to the current-regulator, the moisture of his breath condenses upon the contact points or adjacent parts of the regulator, interfering with its action and spoiling the articulation. The improvements relate chiefly to means for remedying or obviating these defects. Prof. Thompson proposes to employ mirrors, sound reflectors or reverberators (one form of which is shown in Fig. 1, in transverse section), consisting of glass, metal, wood, or other material, by which the sound waves are turned aside from their straight or direct path, and are made to converge upon the current-regulator, precisely as rays of light may be turned aside or converged by a polished mirror. If actual mirrors of polished metal or silvered glass are employed for this purpose, they have the additional advantage of revealing to the speaker the presence of moisture. But in any case the mirror, reflector or reverberator serves to collect the sound waves as they come from the speaker's mouth, and to direct them on to the current-regulator while intercepting moisture from the speaker's breath. M is the mouth piece or tube; C is the current-regulator; R is the reverberator. An adjusting screw and an outlet cock for the water which collects in the mouth tube are also provided where necessary. The mouth pieces, hitherto used on ordinary transmitters, are not intended to serve either as reverberators or as protectors from moisture, and Prof. Thompson finds that mouth pieces for this purpose must, as shown in Fig. 2, be deep and of conical or paraboloidal form. Another part of the invention consists in employing, for the current-regulator, such materials as are at once neither hygroscopic, nor liable, by their properties with respect to heat, to condense films of moisture, while at the same time they are good conductors of electricity. Prof. Thompson prefers to use, as materials for the current-regulator, either spongy platinum, carbide of platinum, boron, coke, carbon, or elastic carbon specially prepared, having first deprived such materials of their hygroscopic properties by treatment with petroleum, or with other suitable hydrocarbon, solid or liquid. In some cases, and especially where the contact surfaces of the current-regulator are of platinum or other metal, he finds it convenient to keep their surfaces constantly moistened with petroleum or other hydrocarbon by supplying them through a cotton filament in communication with a small lubricator or oil vessel. The improvements also partly consist in so arranging the conductors or electrodes, or other parts of the current-regulator, that the points of loose contact can be actuated by the sound waves, whilst they are protected from the moisture of the breath by some portion of the conductors or electrodes projecting between the contact points and the breath of the speaker. An example of such an arrangement is given in Fig. 4, wherein the contact points C are protected from the breath by making one of the electrodes in the form of a cup, against the concave or hollow face of which the contact point on the other electrode is directed. The improvements relate further, to the form of the conductors or electrodes, combined to serve as the current-regulator. The current-regulator of Reis, consisting of one piece of platinum resting lightly against another, is imperfect, except when, as in some forms of Reis's instrument, one or both of the pieces of metal are fixed upon springs or some equivalent elastic support; otherwise the current is liable to very abrupt interruptions. In Fig. 3 is shown a current-regulator, wherein the two contact pieces are held upon springs S, S; one of these springs is fixed to an adjusting frame B, and the other is fixed to an insulating block K, for it is found that when there are many points of contact instead of but a single pair of such points, there is less liability to such abruptness. Multiple contacts, therefore, are advantageous. One of the improved forms of current-regulator consists of a grating or framework of prepared carbon or metal tongues, so connected that the current cannot pass from one tongue to the next except through a piece or pieces of good conducting carbon or metal suspended, or resting in loose contact against the tongues. In the instrument shown in Fig. 1, the current-regulator C consists of an inclined grating of carbon strips, against which the voice waves are reflected by the reverberator R, and upon which rest light balls of carbon, or of metal suspended from hooks by silken strings. In some cases, where a highly powerful action is desired, the air waves are caused to act first on a vibrating tongue which then transfers the vibrations indirectly to the current-regulator or contact points C. Such a vibrating tongue is shown at V, in Fig. 5, where it is attached behind a flanged tube T, the contact points or current-regulator C being on the same face of the tongue V as that against which the voice waves impinge. This tongue may be itself an electrode, and serve as part of the current-regulator, in which case it is formed of metal, carbon, or elastic conductor, whether anhygroscopic or not.—*English Mechanic.*

RECENT INFLUENCE-MACHINES.

SEVERAL modified types of influence-machines have recently been brought before the public, and as they are both cheaper and more efficient than the older forms of Töpler, Holtz, and Bertsch, will probably find general acceptance. Of the newer forms, those of Voss and of Wimshurst are the most prominent.

In the Voss machine, which may be regarded as a modified Töpler machine, there are two discs of varnished glass, one stationary, the other rotating in front of it on an axis which passes through a central hole through the fixed disc. A pair of pulleys with a strap provide the rapid movement necessary. At the back of the fixed disc are fixed two armatures, or inductors, of varnished paper, with a narrower central band of tinfoil. These armatures are connected on the right and left respectively with two metal clamps, which nip on to the edge of the disc and turn round in front of the front plate, each being provided at this part with a little metallic brush. Upon the front of the rotating plate are fastened six or eight metal buttons at equal intervals. These buttons are touched as they rotate by the metallic brushes. Nearly perpendicular, and in front of the front disc, is a brass rod, which need not be insulated, also furnished with spikes at each end, and with a little metallic brush to touch the buttons of the rotating plate. The action of the machine is as follows: If a small charge of electricity—say a positive charge—be imparted to one armature—say that on the left—the buttons, as they move past, will be acted on inductively, and if, while thus under the inductive influence of the positive charge, they are momentarily touched by an uninsulated conductor, they will pass on electrified with a charge of the opposite sign. If the front plate rotates in the clockwise direction, each button, as it moves through its highest position towards the right, will thus acquire a small negative charge, which will be given up on arriving at the right side, the projecting arm conveying the charge to the armature at the back. But as the button passes on downwards it will be influenced inductively by the armature behind it, and when touched by the lower end of the vertical conductor, will assume a positive electrification. On arriving at the left side it will, therefore, give up a small positive charge to the left armature, thus charging it more highly than before. Every button, as it goes round, thus conveys the charges induced in it to the appropriate armatures, and exalts their charge. A very few turns given to the handle suffice to charge those armatures to their fullest extent, so that they begin to discharge pale sparks over the discs. But now begins another action. From right to left in front of the front disc lies an insulating bar of ebonite, holding at each end another brass comb, each connected by a crossbar of brass to the knob of a small Leyden jar. As the charges in the armature rise, they act again upon these conductors fixed in front of them, and charge the jars—one positively, the other negatively. A pair of dischargers, with ebonite handles, serve to discharge the jars when full, and with every turn of the winch, when the knobs of the dischargers are separated by a few centimetres' distance, a torrent of sparks is generated. If the machine is kept free from damp and dust, no initial charge is necessary, as the slight friction of the brushes suffice, to give and sustain the requisite preliminary electrification.

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Wimshurst's influence-machine is even simpler, and, if anything, more efficient. It is the result of a long experimental research carried out with great care and skill by Mr. J. Wimshurst, who is well known as an accomplished amateur electrician. The latest of the many combinations which Mr. Wimshurst has designed is depicted in Fig. 2. It consists of two discs of common window glass, mounted upon a common spindle, and provided with driving gear by which an equal speed is given to each, but in opposite directions. Each disc (about fourteen inches in diameter in the smallest size) is well varnished with shellac varnish, and carries twelve narrow strips of thin sheet metal, cemented at regular intervals apart. In front, at about 45°, is fixed a diagonal conductor, armed at each end with a small brush of metallic bristles, which touch the metal strips as they rotate. At the back a similar diagonal conductor is fixed, exactly at right angles to that in front. Right and left are two upright pillars of glass, or ebonite, which carry each a pair of metallic combs, and serve also to support the dischargers, which are carried in an arch over the discs. It appears that in this machine the metal strips affixed to the plates act both as inductors and as carriers. Suppose, for example, that the front plate is rotating clockwise, and the back plate counter-clockwise, If the metal strips descending from the summit on the left on the back disc are charged positively, the metal strips ascending on the front disc from the left will, as they pass under the momentary touch of the brush, acquire a negative charge. As these negatively charged strips of the front plate advance towards the right, they will come to a point where they are opposite the upper end of the hinder diagonal conductor, and here, whilst still acting as carriers to bring the negative charge round to the right side, they will act as inductors, and will influence the strips of the back disc, which will, as they are in turn touched by the hinder brush, acquire positive charges. The strips on the front disc will, therefore, constantly carry a negative charge as they move over the top from left to right, and those of the back disc will carry a positive charge from right to left. In the lower halves of their respective rotations, the inverse of these actions will hold good, the front carriers conveying positive charges from right to left, the back ones conveying negative charges from left to right. The result will, of course, be that the two main conductors on the left and right will become, respectively, positively and negatively charged. Theoretically, a small initial charge must be imparted to some one or more of the carriers, or to one of the two main conductors. Practically, if dry and free from dust, the machine excites itself, and, after a couple of turns have been given to the handle, discharges sparks freely. If the two main conductors are respectively joined to the inner and outer coatings of a large Leyden jar, the discharges take place with short, loud sparks of great brilliancy. If, from any cause, the machine does not at once charge itself, a gentle rub with a silk handkerchief on either of the ebonite pillars will suffice to provide the requisite stimulus. The Wimshurst machine appears to be less liable than any other influence-machine to have the polarity of its charge reversed. It serves admirably for the production of the electric shadows discovered by Holtz and Righi. Mr. Wimshurst is much to be congratulated on the service he has rendered to experimental science in devising so useful and efficient an instrument.—*Nature*.

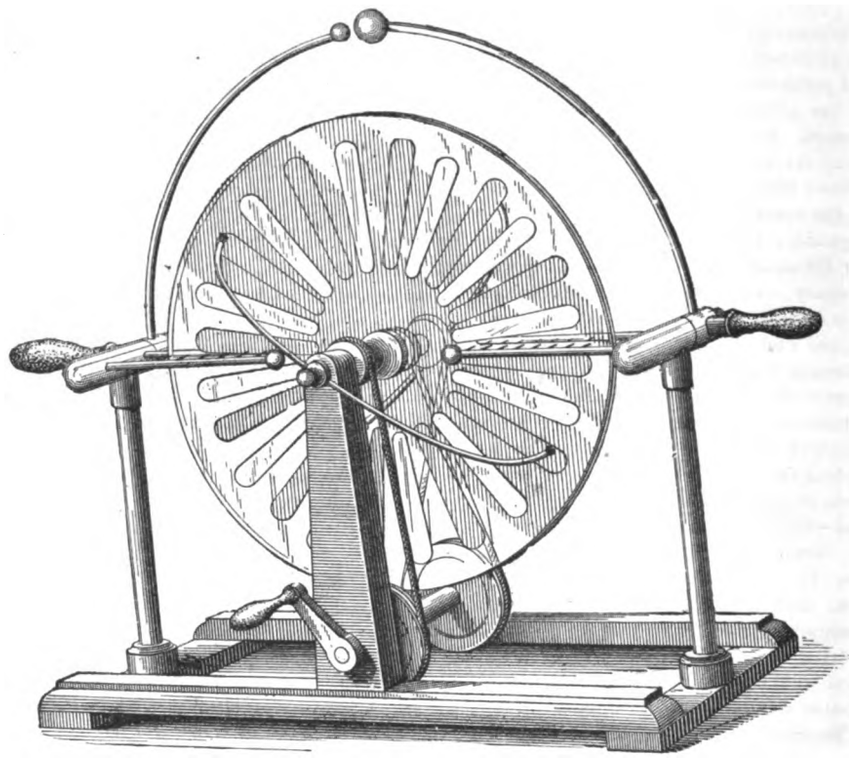

FIG. 2.—WIMSHURST'S INFLUENCE-MACHINE.

THE TRANSMISSION OF POWER BY ELECTRICITY.

CHICAGO, May 2, 1883.

To the Editor of the Electrician:

Dear Sir—At the sixty-sixth regular meeting of the Chicago Electrical Society, held April 23, the following named persons were elected members: George H. Bliss, F. W. S. Brawley, C. N. Fay, J. W. Fortune, P. D Johnston, James D. Sturges, A. S. Porter, and F. H. Wachsmuth.

The paper for the evening, by Prof. H. S. Carhart, of the Northwestern University, at Evanston, was fully illustrated by large charts, containing diagrams and formulæ. We give herewith the full text of the lecture:

The transmission of power by electricity, through a wire offering but a limited resistance, has already been successfully accomplished. Since a dynamo-electric generator may serve also as an efficient electro-motor, the invention of a thoroughly successful generator of electricity from mechanical power solved the problem of the recovery of a large per cent. of this power from the electric current at a more or less remote distance. Even this problem, which can be of only limited practical application, is of great theoretical interest; and its discussion opens the way to the study of the broader question of transmission to a great distance and over great resistance.

Scientific measurements of all sorts have been greatly facilitated in the last few years by the introduction of the so-called "absolute units;" and no department of scientific work has gained more by this advance than electricity and magnetism.

In the absolute system of units only three are fundamental—the units of length, of mass, and of time. All other units are derived from and expressed in terms of these three. The British Association chose the centimetre, the gramme, and the second, as the three fundamental units; and the Congress of Electricians at Paris, in 1881, set the seal of universal scientific approval upon the British Association system. Hence any one who wishes to express himself in current and approved scientific phraseology must employ the "C. G. S." (centimetre, gramme, second) system of units.

From these fundamental units it turns out that the derived unit of electrical resistance is a velocity; and the practical unit of resistance, the *ohm*, is equal to 10^9 C. G. S. units—that is, a number represented by 1

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with nine ciphers following. Similarly the practical unit of electro-motive force is the *volt*, and equals 10^8 C. G. S. units.

Therefore by Ohm's law $C = \frac{E}{R} = \frac{E\ 10^8}{R\ 10^9}$ C. G. S. units of current.

Or, $\frac{E\ (\text{volts})}{R\ (\text{ohms})} = C$ (ampéres) $= \frac{1}{10} C$ (C. G. S. units of current).

That is, an ampére, which is a current due to an E. M. F. of one volt through a resistance of one ohm, is equal to $\frac{1}{10}$ of a C. G. S. unit of current (electro-magnetic). An ampére measures *current strength*. If a current of one ampére intensity flows for one second of time, a quantity of one coulomb passes. The *coulomb* is, therefore, the unit of *quantity*. These two terms have replaced the old expressions "weber" and "weber per second."

In the C. G. S system the unit of force is the *dyne*, a force which will give to a gramme a velocity of one centimetre in a second; if this force acts over a distance of one centimetre it does one unit of work, called the *erg*. But instead of expressing the work done by a current in ergs, it is desirable to be able to express it in the more popular terms of horse-power, which is a *rate* of doing work. The number of ergs of work done by a current is equal to the product of the quantity of electricity into the difference of potential through which it is transferred, both quantity and difference of potential, or E. M. F., being measured in absolute units of the electro-magnetic system.

Therefore, $W = C E$,

or, W (ergs) $= C$ (coulombs) $10^{-1} \times E$ (volts) 10^8,

W (ergs) $= C$ (coulombs) $\times E$ (volts) 10^7.

One horse-power is equivalent to lifting 33,000 lbs. one foot high per minute; equals 550 ft. lbs. per second, equals 76×10^5 gramme-centimetres per second. But since the gramme is a unit of mass, to get the work done, we must multiply by the gravitating force of a gramme, or 981; that is, a falling body acquires a velocity of 981 cm. in a second. Hence, 76×10^5 gm. cm. per second, equals 746×10^7 ergs per second. Since one horse-power equals 746×10^7 ergs per second, to express the above equation for the work of a current in horse-power, we must divide by 746×10^7.

$$W\ (\text{h. p}) = \frac{C\ (\text{coulombs}) \times E\ (\text{volts})\ 10^7}{746 \times 10^7}, \text{ or}$$

$$W\ (\text{h. p.}) = \frac{C\ (\text{coulombs}) \times E\ (\text{volts})}{746}$$

It is of the highest practical importance, therefore, that our instruments for measuring current strength should be graduated in *ampéres*; and those for difference of potential between two points in *volts*, in order that we may quickly and readily determine the amount of energy absorbed between two given points in horse-power, simply by multiplying together the numbers expressing ampéres and volts, and dividing the product by 746.

Dr. Siemens has suggested that the unit of power be the Watt, which is $\frac{1}{746}$ of a horse-power. Hence the product of ampéres and volts is Watts.

If we substitute in the general expression for the energy of a current, $W = C E$, the value of C, or $\frac{E}{R}$, we have

$$W = \frac{E^2}{R}$$

This shows that when the resistance remains constant, the work done by a current, or the energy it represents, varies directly as the square of the electro-motive force.

But if an electro-motor be included in the circuit, the reaction between the fixed magnets and the moving armature generates an inverse E. M. F.; and the actual E. M. F., producing a current through the wire connecting the generator and the motor, will be that furnished by the source of supply, *minus* the counter E. M. F. due to the motor. Calling these E and e, the current will be $\frac{E - e}{R}$, where R is the total resistance in circuit.

Hence, $W = C E = \frac{E(E - e)}{R}$ for work done by the generator; and $w = \frac{e(E - e)}{R}$ for that given out by the motor, both measured electrically.

Let us now illustrate this diagrammatically by the method of Prof. Silvanus Thompson, in order to represent to the eye both the *maximum rate* of working and the *maximum efficiency* of the motor.

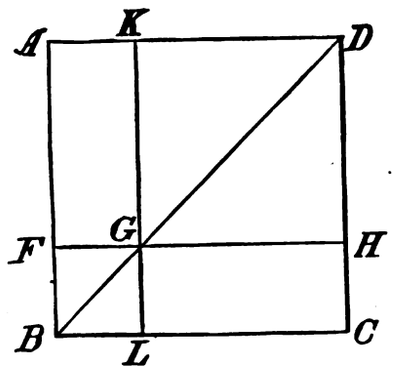

Fig. 1.

The figure is a square, and either side, as $A\ B$, represents the E. M. F. of the generator when the motor is at rest. $B\ F$ represents the counter E. M. F. of the motor. $A\ F$ is, therefore, $E - e$, and the area $A\ F\ H\ D = E(E - e)$, and area $G\ L\ C\ H = e(E - e)$.

If the resistance remains constant, these areas will represent the energy absorbed by the generator, and that given out again by the motor. In both cases the energy is measured electrically, and the machines are supposed to be perfect. The ratio of the two areas on the diagram is, accordingly, the measure of the efficiency of the motor.

Fig. 2 is intended to illustrate the law of *maximum rate of working*.

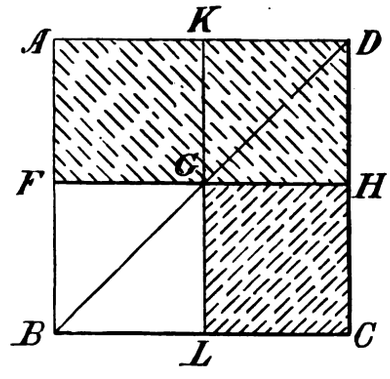

Fig. 2.

The point G is at the middle of $B\ D$. Since this point always lies on the diagonal $B\ D$, the area representing the work done by the motor must always be inscribed in the triangle $B\ C\ D$; and of all rectangles so inscribed, the square $G\ L\ C\ H$ has the greatest area. But the area of the square is exactly half that of the rectangle $A\ F\ H\ D$. Hence, work by the motor is done *most rapidly*, when the energy it absorbs is half that derived from the source of supply. This is known as Jacobi's law of the maximum rate of working. The *efficiency* of the motor is, accordingly, only 50 per cent. when it is doing work at the most rapid rate, with a given source of supply. Maximum rate of working and maximum efficiency are, therefore, clearly not identical.

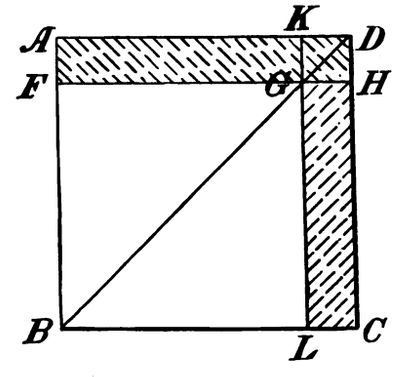

Fig. 3.

Consider further, Fig. 3, when the speed of the motor is still higher, and the counter E. M. F. correspondingly great. The point G is still nearer D; the area $G\ L\ C\ H$ is approaching $A\ F\ H\ D$ in value, and the efficiency of the motor is nearly a maximum. The area of the small square $K\ G\ H\ D$ represents the loss due to heat-waste in the resistances. That the efficiency may be a maximum, the heat-waste must be a minimum. It is, therefore, evident that the efficiency is a maximum when the motor is running with a velocity nearly equal to that of the generator. In other words, the maximum of power employed will be turned into useful work when the motor is running under a very light

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load. Maximum rate of working, however, is attained at a theoretical efficiency of 50 per cent. But when the motor is converting the largest possible proportion of the energy employed into useful work, it is running under a very light load. This is analogous to battery power required for electroplating. The greatest economy of working is to use a current of E. M. F. just sufficient to decompose the metallic salts employed. If double this E. M. F. is used, the rate of electro-deposit will be doubled, but it will be at the cost of four times as much zinc.

For economical working in the transmission of power, it is necessary that the difference between the E. M. F. of the generator and the motor be small. The question of the absolute values of these E. M. F.'s is one now to be considered From the above expressions for the energy absorbed by the generator and that returned by the motor, we see that the ratio of the two is simply the ratio of E and e, provided their difference and the resistance remain constant, which is equivalent to saying that the current remains constant. It follows, directly, that the higher the direct and counter E. M. F.'s, the greater the power transmitted with a given current over a given resistance.

Let us illustrate, by reference to the Gramme machine, used in the Chatham experiments in England. The following data are given:

E — 69.9 volts.
r — 0.15 ohm.
r' — 0.06 "
R — 0.65 "

In which r is the resistance of the field magnets, r' of the armature, and R the external resistance. It follows, that

$$C = \frac{69.9}{0.86} = 81.22 \text{ ampéres.}$$

$$W = 81.22 \times 69\ 9 = 5677.3 \text{ Watts} = 7.6 \text{ h. p.}$$

Suppose, now, the total resistance be increased to 10 ohms, and that the E. M. F. be so increased that the same current of 81.22 ampéres flows. The E. M. F. will then be 812.2, for

$$C = \frac{812.2}{10} = 81.22 \text{ ampéres,}$$

as before. In order to furnish this current through 10 ohms resistance, the dynamo would absorb 88 h. p., instead of 7.6 as before. Further, let the dynamo be connected with a motor running so as to produce a counter E. M. F. of 612.2 volts.

Then the following are the data:

E — 812.2

$E - e$ — 200 $\qquad r + r' + R$ — 10

e — 612.2

Hence, $C = \frac{200}{10}$ — 20 ampéres.

$$W = \frac{812.2\ (812.2 - 612.2)}{10} = 16{,}244 \text{ Watts, or } 22 \text{ h. p.}$$

$$w = \frac{612.2\ (812.2 - 612.2)}{10} = 12{,}244 \text{ Watts or } 16.4 \text{ h. p.}$$

Let the resistance be further increased to 100 ohms, and the E. M. F.'s to 2,500, and 1,500 volts respectively.

Then $C = \frac{E - e}{R} = \frac{1000}{100}$ — 10 ampéres.

$$W = \frac{2{,}500\ (2{,}500 - 1{,}500)}{100} = 25{,}000 \text{ Watts, or } 33.5 \text{ h. p.}$$

$$w = \frac{1{,}500\ (2{,}500 - 1{,}500)}{100} = 15{,}000 \text{ Watts, or } 20.1 \text{ h. p.}$$

Thus, while the current in the three cases varies from about 80 ampéres to 20, and then to 10; and the E. M. F. of the generator rises from 69.9 to 2,500 volts, the power absorbed passes from 7.6 h. p. to 22, and finally, to 33.5. With a decreasing current, therefore, and an increasing resistance it is possible to transmit more and more power, provided the E. M. F. be made sufficiently high.

These results show, conclusively, that if we desire to transmit any considerable amount of power over a resistance as great as 75 or 100 ohms, we can do so with reasonable efficiency only when the generator dynamo and the motor dynamo, are so constructed as to yield a very high E. M. F., the one direct and the other reverse or counter. Then, with a given difference of E. M. F. between the two machines, and a given resistance in the main circuit, the efficiency of the combination and the power transmitted will vary almost directly as the E. M. F. of the generator, the current intensity remaining the same.

This conclusion, which seems at first self-contradictory, becomes evident when we consider that the energy represented depends not on the current strength alone, but on the E. M. F. and the current conjointly; and in this combination of two dynamos, we have the means of varying the effective E. M. F., which determines the power transmitted, while the current intensity remains the same. For a short circuit of low resistance, comparatively low E. M. F.'s will suffice; while for high resistances correspondingly high E. M. F.'s must be employed. This is in reality no new law, though it has been sounded abroad of late in certain quarters with a great flourish of trumpets. When Prof. Joseph Henry took up the task, in which others had failed, of producing at a distance mechanical effects which had previously been obtained only with a short wire of low resistance, he made the capital discovery that he must do two things; first, increase the E. M. F. by joining a number of cells of battery in series; and, second, increase the number of turns of wire on the magnets of his receiving instrument. Exactly the same method must be pursued in transmitting power to a distance by means of dynamos. The E. M. F. of the generator must be increased, and the number of turns of wire on the armature of the motor must also be multiplied, or the same result accomplished by other and corresponding means.

But what practical limits are placed on the increase of E. M. F? There are three methods of exalting it.

First, by increasing the strength of the magnetic field due to the fixed field magnets.

Second, by increasing the number of turns of wire, and, in consequence, the resistance of the armature.

Third, by increasing the velocity of rotation of the working magnet.

With only these means at command, the limit of attainable E. M. F. is not indefinitely high. This fixes a corresponding limit to the resistance over which power can be economically transmitted. For the economical transmission of power several hundred miles, over a conductor of moderate size, an E. M. F. comparable with that furnished by a Holtz machine would be needed. Further, the employment of E. M. F.'s of such magnitude is attended with great danger, even when both the direct and return conductors are insulated. An accidental short circuiting of the conductor is liable to generate a large amount of heat; and if such short circuit is through the person, death must follow. This latter result will most certainly take place if the current is characterized by a dangerous discontinuity, or intermittency. Such a current need not be an alternating one. In nearly all high E. M. F. dynamos, continuity of current has been sacrificed to strength of magnetic field. Professors Ayrton and Perry have devised a method of measuring this discontinuity, by means of an induction coil having low resistance in both the primary and secondary wires. When a current of ten ampéres, from a three-light Brush dynamo, was passed through the primary of the coil, an "ammeter" indicated a reverse current of five ampéres in the secondary. This reverse current was produced by the discontinuity of the main current repeating itself at such short intervals of time as to completely elude detection by any of the ordinary methods. Such intermittency in the current greatly augments the danger to life in case of accidental short circuits; or, indeed, where a partial ground is made by contact with an uncovered wire.

The practical transmission of power, by electricity, to any considerable distance, has thus far been quite limited. Dr. C. W. Siemens says, that "probably Sir Wm Armstrong was the first to take advantage of ascertained facts, in lighting his house at Cragside during night time, and working his lathe and saw bench during the day, by power transmitted through a wire, from a waterfall nearly a mile distant from his mansion."

In 1879, Dr. Werner Siemens operated an electric railway, at the Berlin Exhibition, 900 yards long and of 2 feet gauge. The car carried twenty persons at a trip.

The Lichterfelde line has been in operation since May 16, 1881. It has a gauge of 3 ft. 3 in., is 2,500 yards long, and is operated by two dynamos, developing an aggregate current of 9,000 Watts, or 12 h. p. It has never failed in accomplishing its daily traffic. What its relative economy is, is not stated.

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The tramway at the Paris Exposition of Electricity was about 1,640 feet in length, and of 4 ft. 8⅛ in. gauge. In this line, contact was made with the suspended conductors by means of metallic bolts, drawn through tubes with a longitudinal slit. Ninety-five thousand passengers were carried within the period of seven weeks. Even when fully loaded, the car passed a considerable grade on entering the "Palais de l'Industrie," at a good speed.

Another electric tramway has just been successfully opened between Portrush and Bush Mills in the North of Ireland, a distance of six miles. The installation was made by the Siemens' firm of London. The rails on this line are three feet apart, and are not insulated from the earth, but are joined electrically by copper bolts, and form the return circuit, the current being conveyed to the car through a T iron placed on short standards. At present the power is supplied by a steam engine at Portrush, giving motion to a shunt dynamo of 20 h. p.; but the intention is to utilize water power near Bush Mills by means of three turbines of 40 h. p. each. The working speed of this line is restricted, by the board of trade, to ten miles an hour. This speed is readily attained, although the gradients are decidedly unfavorable, including an incline of two miles at a gradient of 1 in 38. It is intended to extend the line six miles beyond Bush Mills, in order to connect it with the North of Ireland narrow-gauge railway system. Theoretically, the most desirable system for street cars is to carry the store of energy in the tram itself instead of transmitting it over long distances. This plan has been tried with only moderate success thus far by the Electrical Storage Company of London, on the lines of the West Metropolitan Tramway Company. The accumulators are intended to furnish motive power for seven hours, the car accommodating forty-six passengers, and weighing, when loaded, seven tons. This plan appears to be entirely feasible; for while there is a loss of energy in a secondary battery, there is also a loss in transmitting over conductors from a central station. So also there is great loss in transmitting power mechanically by means of a wire cable. Consider only, the immense inertia of the cable, the friction, and the loss due to rigidity in passing round curves on the cable railway.

To sum up the points established:

1st. The maximum rate of working is attained when the motor converts half the energy supplied by the generator into useful work. This is Jacobi's law.

2nd. Maximum efficiency is attained only by allowing the motor to run under a light load at a high speed. The rate of working is then slow, but the largest possible proportion of the energy supplied is converted into useful work.

3d. When power is transmitted over considerable distances, the E. M. F. of both generator and motor must rise with the resistance.

4th. With a given current over a given resistance, the power transmitted will increase directly as the E. M. F. of the generator rises; and the efficiency of the motor increases under the same conditions.

5th. A necessary limit to the E. M. F. is fixed by the mechanical conditions, and the scientific theory of the dynamo machine. Hence, the power that can be transmitted by electrical means over considerable resistances, is also limited, so far as known methods are concerned.

6th. The practical details of transmitting power electrically have not yet all been satisfactorily worked out; but enough has been done to indicate that the conclusions arrived at by theory are practically tenable.

The paper elicited considerable discussion, and many enquiries. The president announced that the annual election of officers would occur at the May meeting.

SCRIBE.

—— THE UTICA *Observer* says: That on the 12th of May, Messrs. Callanen & Parker, of Utica, set their long-distance telephone into a circuit of five Western Union wires (No. 9 galvanized iron), running between Utica and Albany, making a circuit of about 500 miles of continuous wire. The transmitter worked admirably, and was heard distinctly. As the Postal Telegraph Company uses copper wire with a steel core, which has a conductivity three times greater than the No. 9 galvanized wire used by the Utica inventors, Mr. Callanen claims that his test is equal to one of 3,000 miles on a copper steel cored wire, and that their transmitter is thus three times better than the one in use between New York and Chicago.

UNDERGROUND COMMUNICATION.

AT a meeting of the general committee on underground electrical communication, held at Room 47, 115 Broadway, May 7th, the following sub-committees were appointed:

SUB-COMMITTEE ON ELECTRICAL AND MECHANICAL DEVICES.

Albert B. Chandler, Joseph P. Davis, Frederick H. May, Henry Morton, Henry W. Pope, Garret S. Mott, Elihu Thomson, J. Eliot Smith. Instructed as follows:

It shall be the duty of the committee on electrical and mechanical devices, to examine inventions now in use, or that may be presented to it; to give notice to inventors as to the nature and extent of the requirements, and state the problem to be solved, with the purpose of concentrating inventive effort in a practical direction; and generally, to consider and report, for the instruction of the general committee, the state of the art; and that the difficulties are, or are not, surmounted, or, in the judgment of the committee, surmountable; and in default of an ideal and perfected system to make such recommendations to the general committee, as may in its estimation seem worthy of adoption, as a partial or temporary remedy of the difficulties encountered, pending the invention and perfecting of a completely satisfactory system. To report in the first instance to the committee on business.

SUB-COMMITTEE ON LAW AND FRANCHISES.

Leonard E. Curtis, Sherburne B. Eaton, William M. Ivins. Instructed as follows:

It shall be the duty of the committee on law and franchises to examine the laws and franchises granted by the State and city, and the general legislation favorable and unfavorable, bearing upon the subject; to determine whether any further powers are required, and if so, what, in order to carry out the plan of underground electric communication in the interest of all the electrical corporations, as approved by the committee on electrical and mechanical devices, and whether or not any general law on the subject is desirable; and further, in the event that the committee on inventions adopt any system, invention, or device, which is the subject of a patent of the United States, to examine, or cause to be examined, the validity of the same, and its scope and sufficiency. To report in the first instance to the committee on business

SUB-COMMITTEE ON BUSINESS ORGANIZATION.

Augustus C. Richards, Clark B. Hotchkiss, Charles R. Flint, Rowland R. Hazard, Thomas J. Montgomery. Instructed as follows:

It shall be the duty of the committee on business organization, if it shall appear from the conclusions of the two other committees, that a system is devised, or can be formed out of existing material, and that the required laws and franchises exist, to frame, for the consideration of the general committee, a plan of organization for carrying into effect the recommendations of the other committees, which shall include the formation of an independent company for that purpose, if that is deemed the better way, with the necessary by-laws for the same, and a system of control in the interest of the contributing corporations, it being understood that upon the completion of the work of the committee on business organization, the general committee shall be called together to act upon the reports of the three committees.

—— AN ELECTRIC LIGHT introduced in a Pennsylvania coal mine the other day, scared a lot of mules there out of their wits; and miners said it was the first time one of the animals was ever known to show fear underground.

—— *Engineering* states that the commission of the Vienna electrical exhibition is preparing iron cases, or screens, for the protection of the watches of those whose duty will carry them into the vicinity of powerful dynamo machines. The very serious mischief that was done to many valuable watches in the early days of electric lighting, led to the production of a machine by which the watch was steadily turned in front of a magnetic pole, until it was again demagnetised, but it will, no doubt, be more satisfactory to the owners of good watches to avoid the necessity of such experiments.

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UNDERGROUND CONDUCTORS.

IN our last issue, we referred to the action taken by the twenty-five telegraph, telephone, electric light and other electrical companies, doing business in this city, in organizing a general committee to consider the subject of a comprehensive system for placing their circuits underground. This committee has, since then, appointed sub-committees, of which we give the details in another column. As the actual work to be done will fall, for the most part, upon these sub-committees, we are pleased to see that excellent judgment has been shown in making them up.

The task which it is proposed to undertake, is by no means an easy one. The practical difficulties standing in the way of a satisfactory underground system, are probably greater in New York than anywhere else. Even if proper insulation can be secured, and induction obviated, we are met by the fact that the space beneath the pavement is, in very many of the streets, already fully occupied by sewers, gas pipes, water pipes, steam pipes, and pneumatic tubes, and that the number of circuits to be provided for is very great, and rapidly increasing.

Much good must result, however, from a thorough, practical investigation of the whole subject, such as this committee proposes to make.

There can be no doubt of a growing impatience on the part of the public, of the great accumulation of poles and overhead wires in the streets of our principal cities. Bills introduced in the legislatures of several of the States, and ordinances proposed or passed by many municipal bodies, indicate a disposition to legislate all circuits, in large cities, either underground or out of existence. These terms would, probably be, in many cases, synonomous, as for very many of the uses to which electric circuits are put, none of the proposed underground systems have been found reliable and efficient.

Legislators, not understanding this, and believing the only question involved to be one of slight additional expense, have been disposed to make regulations which, if enforced, would greatly restrict and cripple the business of all the electrical companies. Even if the question of expense were the only one, no stringent regulations should be adopted, without very careful consideration. Frequently, the development of a new business depends, at the outset, upon cheapness and rapidity of construction. The telephone business, for example, would probably not have reached a tenth part of its present magnitude under a prohibition of the use of overhead wires, even if any of the proposed underground systems were available for telephone circuits.

After all, the main question is, whether the benefits conferred on the public by the electrical companies, compensates for the inconveniences arising from the occupation of the streets with poles and wires. We think there can be but one answer to this question. The people of Chicago or St. Louis, for example, would probably bear with equanimity much greater evils than they are now suffering from overhead wires, if it were a question of having the circuits as they are, or not at all.

When it is generally understood that the difficulties in the way of getting the wires underground are more largely mechanical and electrical, than pecuniary, and that the companies are endeavoring, in good faith, to overcome them, there will be a much more conservative feeling in regard to legislation.

The work of the committee, if properly conducted, will be of importance, not only as bringing us nearer to a satisfactory solution of the problem, but as an assurance of the good faith of the companies, and as a means of information to the public.

The Gramme Company deserves great credit for taking the initiative in the matter; and the prompt coöperation of all the other companies, shows the very general interest which is felt in the subject.

THE INDIRECT VALUE OF THE ELECTRIC LIGHT.

THE results of experience add new elements of value to the electric light; matters formerly assumed to possess slight importance, have proved to be of great worth, while from day to day one learns of new applications, wherein the electric light has served to widen the scope of industries which it illuminated. These advantages are generally independent of the expense of the light, either in itself, or in comparison with other methods of illumination.

The vexed question of cost of electric light, is still in an unsettled condition, just as the same matter is unsolved in other industries. The members of the associations, devoted to the several leading industries, have long discussed the true cost of a ton of pig iron, of a bale of cotton, and of a bushel of wheat. The most careful observers disagree with each other in details, and final results.

In estimating the cost of lighting by electricity, the results vary with the opinions of the computers; elements of conjecture are amplified or diminished to any possible extent. We have seen such estimates based upon an average use of the light for two hours a day, where the cost of power was assumed as that necessary for the continual operation of the dynamo machines for ten hours daily; the assigned reason for such an extraordinary method of procedure, being that the establishment had facilities for the production of that power. Suppose the manager of a mill should report in a dull season, a production of cloth based upon the total capacity of the machinery, there would be a keen search for the missing goods.

On the other hand, one of the electric lighting companies published a letter from a manufacturer, who used a sufficient number of lights to require at least eighty horse-power, in which the statement was soberly made that "the increase of fuel required to run the dynamos was inappreciable." In the face of such diverse statements, and methods of calculation, it is well nigh impossible to make any report of value on the cost of electric lighting.

In all these estimates, the extent of the illumination is either disregarded, or compared with some previous methods of lighting, with a snap judgment which is unreliable. Whenever electricity is substituted for other

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methods of light, the result is always unsatisfactory, unless a notable increase of light is furnished; because electricity is capable of furnishing increased illumination, more light is demanded in every instance.

As a general matter, it may be stated, that cost is no measure of value; the true measure of value is the worth to the consumer, rather than to the producer.

Several years ago, some tables were published, showing the cost of lubrication in a number of cotton mills. Over fifty of these mills were engaged in the manufacture of print cloths; making the same kind of goods; were equipped with similar machinery, and competing in the general market. In some of these mills, the item of lubrication for each pound of cloth produced, was four times as much as in others; and a curious fact may be mentioned in this connection, that of the two mills, where the cost of lubrication was the greatest, one used the most expensive, and the other the cheapest oil of any on the list; the general result indicated that the greatest economy resulted from the judicious use of a good oil.

The merits of electric light, consist in the indirect matters of its value over other methods of lighting, rather than any difference in the cost, as compared with gas or oil. In this connection, we wish to cite a few instances where the worth of the electric light has been of great value to the places where it is in use.

In photography, it has furnished pictures of mines, caves, the interior of the great pyramid and places beyond the reach of sunlight. Photographers have studios in places more convenient of access, and can take sittings independent of time or weather. In one studio in this city, the shadow effects are controlled by giving a slight motion to the arc lamp used to light the room. As the operator has the conditions of illumination wholly within his control, the results are more satisfactory than when variations of light must be allowed for by the artist.

A circular recently issued by a photo-engraving company, informs its patrons that their plates can now be delivered promptly without regard to weather, and, in cases of urgency, work can be prosecuted during the night, as the use of the electric light in photography has rendered them independent of sunlight. Every business man can appreciate the worth of appliances which relieves an establishment from bondage to the whims of the clouds, and permits a continuous operation with all its attendant advantages.

A large machine shop in Connecticut was engaged upon a contract for munitions of war for a South American government. Much time was required at the commencement of the work in the preparation of the necessary special machinery, and it became evident that the completion of the contract would be delayed, and subject the establishment to a heavy forfeiture. The foundry was poorly lighted by windows on two sides, and it was impossible for gas to furnish enough light for finishing the moulds. Three electric lights enabled the work to be prosecuted with despatch, and the contract was fulfilled within the stated time.

It is well known that in those processes of manufacturing, where machinery has developed the sub-division of labor to a great extent, much of the success is due to the stability of a well balanced and continuous organization of the employees; irregularities of attendance, and enfeebled health, diminish the production of that machine, and other things being equal, rob those who attend to subsequent processes of manufacture of a proper share of work. As competition increases, the importance of giving due attention to the healthful surroundings of artisans and employees is receiving attention.

The electric light neither consumes nor heats the air, and thus tends to render the help keen to observe the work which the flood of light renders more clearly visible.

These matters are more noticeable where continuous night work is carried on. The production of a certain mill, engaged in spinning cotton with two sets of employees, increased over ten per cent. after the electric light replaced gas. The conditions were particularly favorable for a strong comparison, for, in addition to the continuous operation of the machinery, the building was low, and unprovided with any system of ventilation, and sickness was so prevalent among the help that their attendance was very irregular, until the electric lights were introduced.

The electric light introduced a new complication in the labor problem in a New England mill, where the weavers struck last winter because they were refused the electric light during the day. The cause of this unusual devotion to electricity was due to the fact, that they were paid by the piece, and soon learned that the sharp shadows of the arc light enabled them to detect a missing thread at once.

The electric light has been of service in tunnelling, and is beginning to be introduced into mines.

In lighting the cavities of the human body, it has extended the field of the surgeon's skill.

In a field of applied science, whose results have proven of especial value to our fisheries, the United States Fish Commission are to use electric lights during the coming Summer to illuminate both the surface and the depth of the sea; and it is expected that this will add even more to the sum of knowledge of marine life than its other researches in the past.

THE CHICAGO EXPOSITION OF RAILWAY APPLIANCES.

THE Exposition of Railway Appliances, which is just opening at Chicago, bids fair to be of great importance in electrical matters. A sufficiently liberal interpretation has been given to the term, "railway appliances," to take in nearly all the important industrial applications of electricity, and, we understand that some of the exhibits of electrical apparatus will be of great interest.

The electric light companies, in particular, are exhibiting their latest improvements in apparatus in actual operation, so that a good opportunity will be afforded for a comparison of the different systems.

The United States Company is exhibiting arc and incandescent lights, and transmission of power; and, in addition to its exhibits, is lighting a large part of the exposition building under contract. The Edison Company is exhibiting incandescent lights. The Brush Company is exhibiting the Brush arc light, and storage battery, and the Swan incandescent light. The Fuller, American, and other companies are exhibiting arc lights.

An electric railway has been constructed under the direction of Mr. S. D. Field, in operating which, as we are informed, a Weston dynamo machine and motor will be used.

We hope to give a more detailed description of these and other interesting exhibits in subsequent issues.

In view of the great improvements which have been made since the Paris exposition, a new series of authoritative tests and measurements seems very desirable. The Chicago exposition furnishes an excellent opportunity for this, which we hope will not be neglected.

—— THE NEW GUION LINER *Oregon*, which is intended to be a faster vessel than the *Alaska*, is to be fitted up with Edison incandescent lamps. The plant will consist of two duplicate 500-light machines and engines.

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FRICTIONAL ELECTRICITY IN MILLS.

ONE of the mills of the Evans Imitation Leather Company, at Salem, N. H., was set on fire in a very curious manner, on the 5th of last March. The goods of this company are a contradiction of the old college song, "There's *nothing* like leather," for it is cloth, covered with a preparation which resembles leather.

In the manufacture of this substance, the cloth is carried between rollers beneath the coating mixture, and the surplus is removed with a long scraper. The compound is mixed with naphtha; and, on the date above mentioned, a man was reaching over the covering machine, when the frictional electricity, generated at the rollers, drew sparks from the man's fingers, which ignited the naphtha and destroyed the mill. In the other mills of this company, copper conductors, leading to the earth, were placed at every place where there was a liability of the production of frictional electricity; so that it is now impossible to obtain a spark by placing the knuckles at any belt.

The present process of calendering paper, electrifies it; and the pile of sheets retain the static charge for a long time. Such paper cannot be printed with any facility, as every printer knows to his cost. In printing the calendered sheets of Gregory's seed catalogue, out of ninety thousand sheets that were given to the printer, eighty-one hundred were utterly ruined, and many others defective.

An example of the ability of highly finished paper to retain a static charge, can be seen by unfolding one of the semi-weekly issues of *Bradstreet's* upon a desk, and rubbing it with dry hands briskly from the centre to the edges; if the air is dry, it will then retain its position upon a shellaced door, for a long time.

F. W. Bacon, the veteran mechanical engineer, has written to *Cotton, Wool and Iron*, an account of some interesting experiments which he made with frictional electricity, in the mills of the Boston Manufacturing Company, at Waltham, Mass., in 1839. He states:

"A belt, some fourteen inches wide, running some 1,200 feet per minute, was run from an adjacent building into the weave shop, over the looms. It was soon seen that four pairs of looms, over which the belts passed, were seriously affected, The weavers declared that it destroyed their hair—that it made it 'stand on end"; if a thread broke, it sought at once the belt; that all the dust of the shop accumulated around them, to fall on the webs when the mill stopped. It was impossible to get weavers to run them. The overseer of the room applied to me to help him out of the trouble, having exhausted his own patience in attempting to remedy the evil. I took a ⅜ inch bar of iron, of sufficient length to cover the width of the belt, drilled holes through it (No. 10 wire gauge) 1½ in apart, inserted *pointed* wires, 2 inches long, fastened it up in the proper place, attached a No. 10 iron wire to the bar holding the points, carrying it off some 30 feet to the water pipe. The remedy was complete; the hair fell, the broken threads ditto, and the dust stopped where it generated. I have used the same thing since, with equal success."

—— A COMPANY has been formed, in London, for the construction and working of an electric railway under the Thames, through iron caissons. It will be worked by means of a stationary engine, transmitting the power to the carriages, which will run separately, start as filled, and occupy about three and a half minutes in the journey.

—— THE WORK OF LAYING pneumatic tubes under Broadway, has been commenced by the Western Union Telegraph Company, who will also lay tubes, in which telegraph wires will be carried. Six of these tubes will extend from the new Produce Exchange building to Forty-sixth Street, and through that street to Fourth Avenue. Man-holes, four feet square, will be built of brick, 400 feet apart, to obviate the necessity of tearing up the pavement, when making repairs.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

III.—ENGINES INDIRECTLY CONNECTED, ONLY.

THE CORLISS ENGINE.

DIVIDING engines used in driving dynamo-electric machines into two principal classes—engines driving indirectly through gearing or belting, and engines directly connected to the armatures—we may profitably devote considerable space to the first class. And, although machines of the kind which have come to be distinguished by the appellation "high-speed engines" may be, and often are, indirectly connected, it is proposed to leave the examination of such engines to a later article on directly connected engines, and here to describe only the "drop-cut-off" engines, or those with "detachable valve-gear," which can only drive the armature of the "dynamo" indirectly.

The first drop cut-off introduced, had a form patented by Fred. E. Sickles, in 1841. This engine was first built for mill purposes, by Thurston, Gardner & Co., at Providence, R. I., that firm then holding the Sickles' patents, except that the marine engine business was retained by Sickles. The modern stationary engine was thus introduced, and was soon extensively made known among steam users by its superior performance when competing with the older engines, which were then usually arranged to expand steam about one and a half times by the lap of the single three-ported valve. A few engines were built of a better design, fitted with an independent cut-off valve on the back of the main valve. These two last named engines would, at best, with good boilers use five or six pounds of coal per hour, and per horse-power, where the Sickles valve-gear would bring the consumption down to four.

Regulation was always effected by a governor controlling a throttle valve. This governor was usually a common fly-ball governor, and its deficiency in power and lack of isochronism, the distance of the regulating valve from the engine valves, and the range of motion required in its operation, and the resistance offered by the packing of the steam, altogether, made this combination a very ineffective regulating apparatus. Thurston, Gardner & Co., substituted for this the Pitcher hydraulic regulator and a register valve, which gave a much better regulation; this contrivance was also isochronous, *i. e.*, it was capable of holding the engine at speed, whatever the variation of steam-pressure or of load.

But an immense step in advance of this, then, best practice was made by Geo. H. Corliss, a young Poughkeepsie mechanic, who had exchanged the *rôle* of sewing-machine inventor for that of the inventor of the most famous steam engine that has appeared since the time of Watt. The Corliss engine was patented in 1849, and rapidly came into use, its remarkable economy, when competing with the best existing engines, the peculiar business tactics of its builder, and the rapidly increasing demand for efficient, and especially well regulated, engines, combining to give it a wonderfully rapid introduction.

The engine is an interesting illustration of a machine which is the representative of a peculiar type, each detail of which is especially adapted to its place in that machine, and is characteristically different from the parts which perform the same office in other engines. The leading features of this machine are:

1. The use of four valves—two steam, and two exhaust—so placed as to reduce "clearance" to a minimum.

2. The use of a rotating valve, capable of being cheaply and readily fitted up, of being easily moved, and of being

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conveniently worked by connections outside the steam spaces.

3. The use of a "wrist-plate," caused to oscillate by a single eccentric, and directly so connected with all four valves that each may be given a rapid opening and closing movement, and held open and nearly still, at either end of its range, by swinging the line of connection nearly into the line between centres, thus permitting nearly a full opening of port to be maintained during an appreciable interval, and a free and complete steam supply and exhaust.

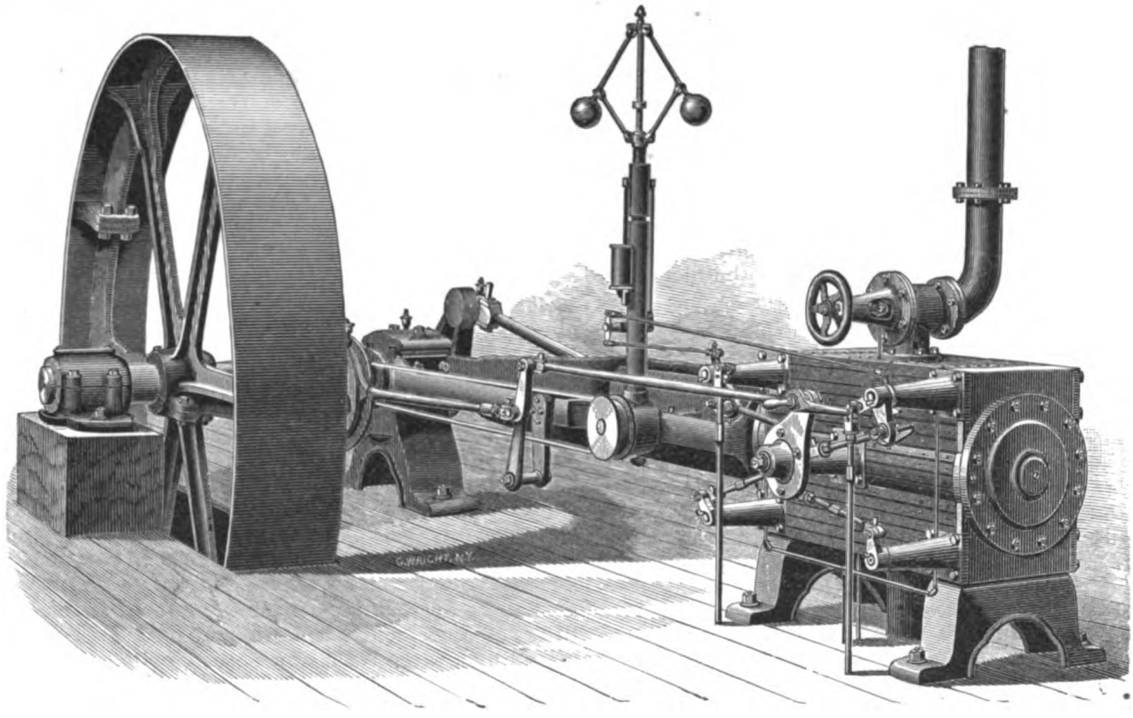
4. A beautifully simple and effective method of detaching the steam valve from the driving mechanism, and of insuring its rapid and certain closure at the proper moment, to produce any desired expansion of steam.

5. A direct connection of the governor, so as to determine the ratio of expansion, while so adjusting the power of the engine to the work to be done, that the variation of speed with changing loads becomes a minimum.

6. Making this latter adjustment in such a way as to throw the least possible work on the regulating mechanism, and thus to give the governor the greatest possible sensitiveness and accuracy of action.

was as novel and as successful as the mechanical device itself. He offered to put his engine in place of rival engines, either with a guarantee of a certain saving, and at a stipulated price, or, often, to take as his compensation the actual saving shown on the books in a stated time. This system was eminently satisfactory to the purchaser, both as making him safe against loss, and as giving him some of that confidence in the engine which the maker himself unquestionably possessed. Corliss' work fully justified his claims, and the expenditure of fuel was brought down to between three and four pounds per hour, and per horse-power, according to size and situation of the engine, with occasionally still better figures in condensing engines.

These engines are now built, not only by the Corliss Steam Engine Co., under the eye of the inventor, but by many other builders. It has found its way into every part of the world; and the engineer visiting Europe, will find a pleasure in observing the general adoption of this American invention in every country, and for every purpose. European makers frequently modify the design, but rarely with the desired effect of securing an improvement in cost or efficiency, and frequently with a decidedly contrary result.



THE HARRIS-CORLISS ENGINE.

7. A form of frame and general design of engine, which gives maximum strength and stiffness, with least cost and weight.

All these features are combined to form a steam engine essentially different, in general and in detail, from the engines contemporary with or succeeding it, except where the latter may properly be classed as Corliss engines. It rarely happens that an inventor succeeds in originating a plan so wholly and so essentially novel; and it is still less frequently the fact, that a peculiarly original device is found superior to all competing machines. In operation, the engine was found to exhibit a remarkable economy of fuel, and a singularly perfect regulation, and to be far more durable and more economical in cost of repairs, on the average, than rival builders supposed possible. It very soon took the leading place in the market.

The inventor established himself at Providence, and put in operation a method of marketing his machine, which

Corliss engines are now very frequently adopted in electric lighting, and are always belted to the dynamos. Their excellent regulation is as important a feature in this application, as is their economy in use of steam. When carelessly constructed, they are, of course, likely to prove wasteful and irregular in action. But that these engines can be made to give very perfect uniformity of rotation will be evident, when it is stated that the writer, in testing engines of this class, has found that the variation of speed was so slight as to be practically inappreciable, even when the amount of work thrown on or off, was a very large proportion of that done by the engine when working at its rated power.

One other reason for the success of this engine is unquestionably the comparatively small cost of its construction, where competing with the earlier forms of engine with detachable valve-gear. Its valve-faces, particularly, and their seats, are surfaces of revolution, and they, as well as a

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large part of the finished work about the engine, being almost wholly lathe-work, the cost of fitting up is comparatively small.

In detail, the engine consists, as shown in the above illustration of one of its standard forms, of a steam-cylinder sustained by any substantial connection with the foundation. The main pillar-block sustains the crank-shaft at the opposite end of the machine, and a strong brace, connecting these two pieces, forms, at the same time, a support for the crosshead guides.

This form of engine-frame, used by Horatio Allen, the veteran president and engineer of the Novelty Iron Works, at a very early date, was adopted by Mr. Corliss, and has been copied from his engines by other builders throughout the world.

The four valves are placed at top and bottom of each end of the cylinder, their rotating stems projecting, and are moved by the "wrist-plate," set usually, as here, at the middle of the cylinder, the valve connections radiating to the four corners, where each is attached to the valve rocking-arm, the exhaust by pin-connections, the steam by a catch, which can be readily "tripped" by the adjustment of a little cam set on the valve-stem, behind the arm. When tripped, the steam valves are closed by a spring in engines now built by Mr. Corliss, and by weights in his earlier engines, and in those of other builders.

The governor is belted from a pulley on the main-shaft, and its oscillations are controlled by a "dash-pot," seen attached to the side of its standard. The governor, having no work to do but to set the tripping-cam, or the equivalent for it adopted by Corliss and others in various designs, is entirely free to adjust itself to the normal position due the speed of the engine, and thus is made perfectly capable of doing the best possible work. Many foreign builders have attached the Porter loaded governor to this engine. The advantage is less obvious here than in engines in which more strength of action is needed.

—— IN RELATION TO A PARAGRAPH in the London *Truth*, which declared that the Edison lamps in the library of the House of Commons went out twice within a period of ten days, Mr. Edison writes to *The Evening Post* to say, that the system used in the House of Commons at the time alluded to was the Swan light. He says that since his lights have been in use in the House of Commons, there has been no failure on the part of any of them.

—— A CURIOUS INCIDENT is reported as occurring on Siemens' electric railway at Portrush. Owing to the fact that as yet only part of the line is furnished with electric conductors, a steam engine is still used as well as the electric locomotive. A few days ago the steam engine while drawing its load along the line, came to a stand through the accident of bursting a boiler tube. News of the disaster having been sent to the terminus, the stationary dynamo-electric machine which supplies the current was set into action, and the electric locomotive despatched to the rescue. It returned an hour later bringing the disabled steam engine behind it.

—— SEVERAL LOCAL electric lighting companies have lately been organized for supplying the public with arc lights produced by the dynamos and lamps of the *Thomson-Houston system*. Among the most successful of these local companies are those at Lynn, Fall River, Lowell, Fitchburg, Hartford, Utica and Kansas City. The parent company has been known heretofore as *The American Electric Co*, of New Britain, Conn., but the control of the company having passed into the hands of capitalists in Eastern Massachusetts, the name of that company has been changed to *The Thomson-Houston Electric Co.*, and the principal office has been established at Boston. The dynamos and lamps are still manufactured at New Britain, but a factory for their production is shortly to be opened at Lynn, Mass.

THE A, B, C, OF ELECTRICITY.

LIEUT. BRADLEY A. FISKE, U. S. N.

PART I.

THOUGH the advance of electrical science, during the past few years, has been so great that none but specialists have been able to follow it, yet the inventions and discoveries which have been made affect us and our surroundings so intimately, that even those who have had the least time to devote to the subject, cannot but feel a personal interest in all that pertains to it. With many, this interest is merely that which every one feels in things new and strange; while with others, it is aroused by the important commercial position which has suddenly been assumed by electrical companies, and by the practical advantages they offer in the way of lighting streets and houses, and economically furnishing motive power for machinery.

The attention commanded by the subject is shown in the daily press. Scarcely a paper can we peruse without finding a notice of some new invention or discovery, or of the extension of electrical systems to comparatively uncivilized quarters of the globe.

The succession of important inventions has been so rapid as to be bewildering. Hardly had the telegraph become a practical thing, upon an extended scale, when electric lights began to be used in Paris; shortly after, came the announcement of the transmission of speech in the telephone; shortly after, we were told that spoken words had been reproduced by the phonograph; then we heard that electricity had been stored in an accumulator; and now, we are asked to believe that we shall soon see distant objects by electricity, as we now hear distant sounds. Probably the most striking feature of the electrical question is, that as yet, no limit can be seen to the increase of the applications of electricity. Many years ago, a limit could be seen to the power of steam; but nothing like this yet looms up before us, with electricity. Even in the oldest branch of electrical science, that of generating electrical currents, discoveries and inventions are being, almost daily, made, especially in generating currents by heat, that threaten to revolutionize every system now in vogue.

The simplest way of getting an electric current is the well-known method, which we have all tried, of putting a piece of zinc and a piece of copper into a vessel of water, to which a little sulphuric acid has been added, and then joining the metals by a wire. What now ensues, nobody exactly knows; but the zinc is found to be slowly dissolving away—being attacked by the sulphuric acid—and the wire to possess many curious properties, which it did not possess before, and which it ceases to possess as soon as it is removed from the metals. These properties are said to be due to a current of electricity, which flows through the wire from the copper to zinc. Whether such a current flows, or not, has never yet been definitely proved; but the hypothesis is a convenient one, and is now generally adopted, all over the world.

Nearly all of the practical applications of electricity have been made by combining electricity and magnetism; for, as is well known, electricity can produce magnetism in iron, and magnetism can produce electricity in wires. Magnetism is, however, found unaccompanied by any apparent evidences of electricity in the natural lodestone, and in steel which has been magnetized by being rubbed upon a piece of lodestone.

But the practical uses of the steel magnet are very limited; while those of a magnet made by passing currents of electricity around a bar of soft iron, are so many as to defy

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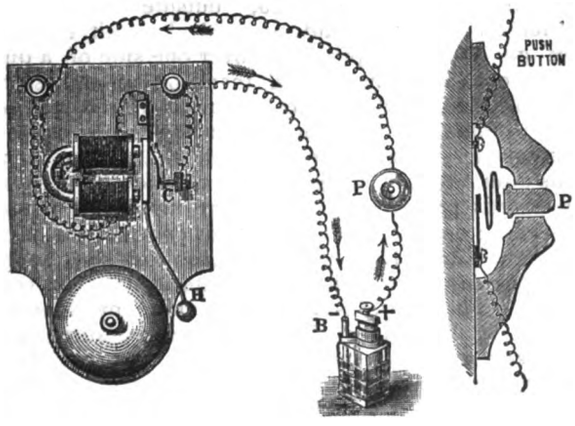
enumeration. No telegraph sends a message from one place to another, no telephone acts, no electric machine, no electric light, no electric apparatus of any kind, it might almost be said, can operate without a magnet of this kind. Its great usefulness lies in the fact, that its magnetization is completely under the control of the current; for, as soon as the current passes, it becomes a magnet, and as soon as the current ceases, the magnetization ceases. So rapid, in fact, is its action, that a magnet of this kind, called an "electro-magnet," can be magnetized, and demagnetized, hundreds of times in one second.

To make an electro-magnet, all that we have to do, is to take a bar of soft iron, and wrap around it a wire, being careful that the turns of wire do not touch each other. To render this operation easy, wire is manufactured which is covered with a coating of some material like rubber, which does not conduct electricity. On now attaching one end of the wire to a piece of zinc, and the other to a piece of copper, placed in the vessel of acidulated water, a current will immediately pass through the wire, from the copper to the zinc; or, to use the terms ordinarily employed in electrical science, from the positive to the negative pole of the battery. If, now, we place a piece of soft iron in front of the end, or "pole," the soft iron will be instantly attracted, and if free to move, will affix itself hard against the pole. If we then "break the circuit," by removing either wire from the battery, or by breaking the wire, the current will instantly cease, and the soft iron will instantly drop off. The electric bell, which we ring by pressing a button, is a simple application of the electro-magnet. When we press a button on the wall of a room at a hotel, we simply force together two wires, one of which comes from one pole of a battery, while the other comes from the other pole. In other words, we "close the circuit," so that an electric current passes. But one of these wires goes around an electro-magnet, at the hotel office. This electro-



magnet, being therefore magnetized, attracts a piece of soft iron placed in front of it, and draws it towards itself. On the other end of this piece of soft iron, which is called the armature, is a clapper, which is near a bell, so that as the armature moves towards the electro-magnet, this clapper strikes the bell. Thus, by pressing a button in our room, we cause a bell to be struck in the office. But the reader will hardly be satisfied with this explanation, for he has noticed, that when he presses the button, the bell does not give out one sound, but emits a jingling sound, as if struck many times. The reason of this is, that a single tap might fail to call attention, whereas, a continuous rattling noise can hardly fail to attract the notice of any one within hearing. The rattling is accomplished by having in the bell a little device—such, that when the armature is attracted towards the electro-magnet, the motion separates two points which were in contact, and through which the current was flowing. As soon as the points are drawn apart, the current is therefore, broken. Being broken, the electro-magnet instantly loses its magnetism, so that it ceases to attract its armature, and the armature is immediately drawn back by a spring. But this motion brings the two points together again, thereby closing the circuit again, which results in again attracting the armature. Thus, the armature automatically makes and breaks the circuit, and is, therefore, attracted towards, and drawn away from, the electro-magnet many times a second; and, therefore, strikes the bell many times a second.

Telegraphing is also an adaptation of the principle of the electro-magnet, in which the operator, in one place (New York, for instance), closes the circuit of a wire which runs from New York to another place (say Chicago), and passes around an electro-magnet at that place; so that, as the operator in New York closes the circuit with his key, the armature in Chicago is attracted, and strikes the electro-magnet with a sharp click. Now, each letter of the alphabet can be signaled, by closing the circuit a certain number of times, and for periods of different durations; so that a practiced ear, on listening to the clicks of the armature, can read each letter as it is made.

The telegraph has now become such an everyday affair, that it is difficult to realize the difficulties put in the way of the early inventors, even by those whose interests it was to promote. It is related, that shortly after the battle of Waterloo, Sir Francis Ronalds invented a system of telegraphy, and referred it to the War Department. This system, though far inferior to those of the present day, was yet a great improvement over the clumsy methods then in vogue, of waving flags and other visible objects. But the war department declined having anything to do with the new invention, saying, "Now that the war is over, telegraphs will be no longer required!"

Of late years, many inventions have been made for sending messages more rapidly than can be done by the hand of a man. In these systems called automatic systems, the sending and receiving are accomplished by machinery. In most of them a long piece of paper tape is perforated with a series of dashes and dots, which correspond to the letters of the message. *B*, for instance, being represented by a dash and three dots (— . . .) would be represented on the tape by a long slit and three holes. To accomplish the perforation rapidly, a perforating machine is used, somewhat similar to a type-writer. The paper tape on which the message is to be prepared, being put in the perforating machine, the operator presses the keys of the machine, in their proper succession; and as each letter is pressed, the corresponding perforation is made in the tape. When the tape has been prepared, it is wound upon a reel. From this reel, it can be rapidly unwound by turning a crank, which winds it upon another reel. In going from one reel to the other, the tape passes over an iron roller to which is attached a wire from one pole of the battery, and under a metal stylus, which is attached to the other pole of the battery. When this stylus rests upon the paper no current can pass, because paper does not conduct electricity. But when a hole or slit passes under the stylus, the stylus drops down and comes into contact with the metal roller, thus making the circuit. It is evident that, when the tape is drawn along at a uniform rate, the current will be made as each round hole and slit pass beneath the stylus, being made for a longer time when a slit passes than when a round hole passes. Now to receive these rapidly succeeding currents, whose duration is inconceivably short, it is clear that we need some exceedingly sensitive device. We find this in a piece of paper soaked in a certain chemical, for when

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a current passes through it, no matter for how short a time, it stains the paper. In using this to receive a despatch sent by the means just described, the piece of paper tape is rapidly drawn between a metal surface and a stylus, the metal surface being connected to one pole, the stylus to the other. Each time the current is made, therefore, a stain will be left upon the paper tape, and the length of this stain will be proportional to the duration of the current. So that, when a slit passes under the stylus, at the sending end, a long stain will be made upon the receiving tape; and when a round hole passes, a short mark will be made upon the receiving tape. Thus the receiving tape will be marked with the same succession of dots and dashes as was the sending tape.

The operator at the receiving end has now only to read off the message, translate it into ordinary language, and send it to the person for whom it is intended.

In practice more than one message can be sent over one wire at the same time. By the invention of duplex and quadruplex telegraphy, in which we find to a great extent the hand of Edison, as we do in every branch of electrical science, two messages can be sent in one direction at the same time that two other messages are being sent in the other direction, or four messages in all. But the apparatus is too complicated to warrant the attempt to explain it in a general article of this kind.

(To be continued.)

NEW YORK ELECTRICAL SOCIETY.

AT the meeting of the New York Electrical Society, May 18th, Mr. Walter P. Phillips described the system of telegraphy invented by himself, known as "Steno-telegraphy." He said:

There is so much confusion, in the telegraphic mind, concerning my devices, that perhaps I may as well explain the objects and aims I have in view.

To make myself understood, I will say, this is an ink writer (holding one of the Phillips' automatic machines in his hand). It is something like the Digney ink writer; something like the Wheatstone; better, I think, than either. The use to which this instrument is put, is to receive contractions, based, primarily, on the abbreviations used by operators, ever since I was a boy, and learned to telegraph, 22 years ago. These contractions—which I have amplified, systematized, and finally developed into a perfect system of short-hand for telegraphic purposes—I call "steno-telegraphy." It differs widely from the old abbreviations, and, where you will find me using "4," for "where," you will also find me employing "T Q," for "the question"; "T F," for "the following," and many other combinations, capable of being quickly committed to memory, of which you probably have never heard. For instance, we say, "3:15 bug aut 12," which means, "At 3:15, the Senate went into executive session, and when the doors were re-opened, an adjournment was taken until 12 o'clock to-morrow." Nor is the system in any way confined to congressional matter. In handling the general run of news matter, we are just as clever. "S. S. N." disposes of "Sir Stafford Northcote, Chancellor of the Exchequer," while "U T C" covers "under the circumstances," and "C K X," "committed suicide." Steno-telegraphy will double, and often treble, the capacity of a single wire, a duplex, or a quad. Mr. W. J. Cook, the inimitable "Bif," sent, from Washington to Cincinnati, in 5 hours and 5 minutes, the great speech of Senator Conkling, delivered in front of Cooper Institute, during the Garfield campaign. It consisted of nearly 20,000 words, and took Mr. Conkling more than four hours to deliver it.

Mr. Cook made an hourly average of nearly 4,000 words. His time, however, has been beaten by Mr. Walter L. Prentice, who has sent 4,600 words in an hour, and by Mr. Fred N. Bassett. The latter sent from Washington to Chicago between 10.30 P. M. and 3.10 A. M. 21,000 words, two full pages of the *Inter-Ocean*. This was done on one side of a quad, with Washington working with Pittsburg on another, and Chicago with Pittsburgh on another. Two operators copied this matter out, and were clear five minutes after Mr. Bassett sent "good night!" I doubt if two operators could have copied more in the same time from expert sending on a much steadier circuit; and I doubt also, if any two senders could have gotten the matter over two sides of a quad in the time consumed by Mr. Bassett using only one side.

I have never had any difficulty in teaching men to send steno-telegraphy. They become familiar with it, so as to average 3,000 words per hour in a few days; but the modern operator knows very little about tape, and I suppose that there are not more than twenty expert tape readers in the country, outside of those reading the double line characters in the American rapid offices, and those whom the Western Union are now teaching to read the Wheatstone tape. In view of this scarcity of tape men, I reason, that if I could take steno-telegraphy on an embosser, or ordinary Morse register, and run it through a transmitter at a low rate of speed, a sound operator could copy out the contraction in full, and we thus could do away with the ink recorder, and the reading sight instead of sound. I went further than this. I made an automatic which utilizes the Morse talent. I have nothing to do with perforators. I adhere to the Morse register, and with the matrix made by it, I transmit into the line, at any desired rate of speed, from ten words per minute to 200 words per minute. I can work with these slips up to the Wheatstone standard of speed, and can take it either on an ink writer or on the sensitive tape, and I can do, what neither the Wheatstone, nor any other system can do, outside of mine — I can let an operator send, on a local circuit, say 60 messages an hour, and put them over one side of a quad at the rate of 120 per hour, take them on an embosser, and then slow them down on a local circuit to 60, 50, 40, 30, 20, or 10 messages per hour, according to the capacity of the receiver. I have demonstrated that I can send 60 words a minute to Chicago, over one side of a quad, or 3,000 words per hour. If, then, the matter be press, and the sending operator entapes it in my contractions, it can be sent at the rate of from 7,000 to 10,000 words per hour. All this is accomplished without the intervention of the perforator. The work is all to be done by Morse men —done by men trained to read copy, done with a Morse key, and consequently, done in a workmanlike and intelligent manner. If any automatic outside of this one, is ever a success, it will be the Wheatstone, and how many men out of the great army of Morse operators in this country to-day will ever take kindly to punching paper with a pair of toddy sticks? In England, where caste pervades everything, it is easy to club men into doing anything; and I understand that the Wheatstone has there been a great success. But the American operator has his own notion about the proper use of toddy sticks, and thus far he has not taken kindly to automatics. Without the co-operation of the Morse men, any new system of telegraphy must fail, and I have endeavored to build up a system calculated to save wires and employ the men who have devoted their lives to learning the business, and whose views, prejudices and peculiarities must be taken into account by any man who aims to improve on the original Morse method.

Mr. Phillips then ran some tape, already prepared, through one of his transmitters at various speeds, ranging

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from 10 words to 100 words per minute. The characters were reproduced on the sounder in circuit with great precision. About 75 words per minute seemed to be the limit of possibility to read by ear. Much merriment was created by the story told by the sounder. The subject was, so to speak, a bird's-eye view of that famous press circuit in days gone by, No. 4 East.

At the conclusion of Mr. Phillips' remarks, Mr. Dan. Boyd, Managing Director of the Electrical Portable Battery and Gas Igniting Company, of Manchester, England, was introduced. He exhibited some novelties in induction coils, portable gas igniters, call bells, etc., and imparted some valuable information to those present. The company he represents use soft iron wire, as well as copper, in the construction of helices. The wire is used bare, and the insulation of the convolutions is effected by winding with the wire a fine cotton thread, which, of course, insulates every convolution from the ones next. Economy of space is the advantage claimed for this method.

Mr. Boyd also exhibited a miniature electric light as a scarf pin. The battery, supplying the current, is so compact that it can be carried in the vest pocket. The light is powerful enough to enable the wearer to read the finest print at ordinary reading distance. Mr. Boyd, at the conclusion of his remarks, presented the society with an electrical portable gas lighter.

The circulating library of the society was inaugurated at this meeting, and it is predicted and hoped that it will be the means of largely increasing its membership and popularity.

OUR PARIS CORRESPONDENCE.

PARIS, May 12th, 1883.

IT was only the following day after the experiments, carried on last February, at the station of the *Chemin de fer du Nord*, with the system of electric transmission of power advocated by M. Marcel Deprez, that we explained in these columns the reasons which made us doubt of their success. Since that time, an attempt has been made to create a certain amount of excitement about this alleged discovery. M. Marcel Deprez has been placed upon a pedestal, the Académie des Sciences has showered the most flattering encomiums upon him, and the government has nominated him officer of the Legion of Honor. It is seldom that we find a *savant* reaping the fruits of his discoveries during his lifetime, and we shall, therefore, not attempt to criticise this rather factitious enthusiasm, but on the sole condition that it is disinterested—a matter which we shall learn some day or other. Still, as the reader will not fail to find an absolute contradiction between my personal views and those of the report of the Académie des Sciences, I think it my duty to offer a few remarks as to the way in which the official committee looked at this problem of the electric transmission of power.

When M. Tresca was invited to make experiments with the apparatus of M. Deprez, he confined himself to stating some industrial results, so as to seem to explain certain divergencies between theory and practice. He passed justice on the exaggerations that prevailed in the beginning, and came to the conclusion that the power received represented only about one-third of that spent.

The committee, which was composed of Messrs. Bertrand, Tresca, de Freycinet, de Lesseps, and Cornu, did not think proper to place themselves on this ground, but wanted to display science, and to prove (what no one doubted) their competency in such matters. They brought up calculations, analyzed all the phenomena to the minutest degree, and, amidst the scientific apparatus, they completely lost sight of the interesting side of the question.

It is of small importance whether the electric transmission of power to a distance was first accomplished by Faraday or not, by producing deviations of the needle of a galvanometer by introducing the induction magnet in the inducted coil. This cannot be regarded in any way as an instance of the transmission of power to a distance, for, at this rate, the mariners' compass might be cited as ante-dating Faraday's experiments. The problem that now excites electricians, and the solution of which would be so important to industry, consists in the transmission of great powers to a considerable distance. When the utilization of the Falls of Niagara is spoken of, it is not for the purpose of running a sewing machine; but the members of the Académie des Sciences do not seem to have considered that the whole difficulty lay in the measure of the power received, and in the distance. They implied that the returns stated by them were absolute, and that we might infer, from the fact of four or five horse-power having been sent for a few minutes to a distance of some eight miles, that 500 horse-power might be transmitted sixty miles by a suitable modification of the machines. It would not be out of the question, then, to ascertain whether there was not a limit to these transmissions by electric machines, but the experiments have yet to be made. The committee indicated the three great principles of the question: the *transport to a long distance of a considerable power in advantageous conditions of cost.* They were kind enough to believe that the first two conditions had been satisfied, although the distance did not exceed eight miles, and the effort received 4.44 horses. As to the last point, not having any precise data, they thought it best to declare that the return was of only secondary importance, as, generally, forces had to be employed that were unutilizable by the distance from their source.

A manufacturer would not be satisfied with such a statement. The whole future of this new application of electricity depends on the value of the produce—that is to say, on the proportion of work received on the generator to the work paid out on the receiver. The fitting up the hydraulic works, the number of machines, and their power, the number of conductors and their diameter, and all other matters pertaining to the cost and the power transmitted, are closely connected with the return. It is, therefore, simply begging the question to write "However small may be the proportions utilized, provided it is cheap, the result will be advantageous."

We will not analyze the report of M. Cornu here, but it can be seen from this one remark, that it is conceived from a purely theoretical standpoint. In that case the labors of M. Marcel Deprez could be unreservedly commended, and the Académie des Sciences, which seems to have known as much about them as of those of Mr. Smith of Oxford, the *post mortem* laureate of the mathematical prize, took advantage of the opportunity to make up for the neglect. During the past eighteen months all the calculations referring to electric transmission of power have been published in every language; to cite only a few of the best known names, Dr. Froelich in Germany, and Mr. Hopkinson in England, have written on the subject, and contributed severally to the popularization of the idea, which was officially announced, for the first time at the International Congress of Electricians in Paris, in 1881.

Nobody at present thinks of disputing the theoretical truth of it, but lengthy experiments must be made before a correct idea can be formed of the importance of this "industrial revolution" as it has been too hastily dubbed. It seems to us that M. M. Deprez has entered on a wrong path in trying to prove too much at once. The predilection he has for a galvanized wire conductor of 4 millimetres (0.157 inches) diameter, entails a considerable increase of resistance in the circuit, and has an injurious influence on the produce.

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Copper wires, although dear, must be employed for long distances. As to fine wire machines designed to give a great deal of electro-motive power with feeble intensity, we believe that they must be modified so as not to require velocities of 1,000 or 1,500 revolutions—as such are not without objection. Experiments to this end are now being made in Paris, and although there has not been such noise made about them as about those of M. M. Deprez, they have been already productive of some remarkable results. The electric company that has been quietly conducting investigations for the past eighteen months has now in fact, definitive models of machines that will transmit from 8 to 30 horse-power several kilometres. It will, doubtless, be seen working at the coming electrical exhibition of Vienna, and that city, where Gramme first exhibited the transport of power, will be the first to judge of the progress made in this line within the past ten years.

There has not been much talk about electric companies for some months past—at least as much as there used to be. They are engaged in strengthening their position, and do not need the publicity of which they made a somewhat too liberal use in the beginning. The advantages of electricity are being more appreciated, however, and its applications are increasing slowly but steadily. Inventors are growing tired of devising dynamo or magneto-electric machines, and regulators. The first patent for the Gramme machines will become public property in a few months, and there is no lack of electric lamps that will work well if carefully constructed.

It is becoming more difficult, therefore, to dispose of patents, or even working licenses. Such financial considerations as these, have dulled the imaginative faculties, and explain the attention and experiments that have now been turned towards the battery. We have already referred to this subject, and we believe it interesting to make some additional remarks at present.

The *Comptoir d' Escompte*, of Paris, which was lighted, during a part of the winter, by both arc and incandescent lamps fed by batteries, is now about giving up the system, owing to its exorbitant cost. The fitting up of the batteries cost more than 300,000 francs, and the working expenses have been in proportion to this figure. It was believed that the batteries would do away with the use of gas and engines, but a gas motor had to be used, and the question is, why not have adopted the electric machines from the outset.

A great many errors have lately been published with regard to the bi-chromate of potash battery of M. Trouve. Mr. Hospitalier shows, by figures in a letter to the *Société Francaise de Physique*, what little economy there can be in this system of lighting. The following is the outlay to obtain one-horse power for an hour, and maintain six incandescent lamps at a luminous intensity of 16 candles:

Wrought zinc plates, - - -	1,460 grams.
Bi-chromate of potash, - -	2,400 "
Commercial sulphuric acid. -	7,200 "

The zincs of the battery are amalgamated, and it may be safely assumed that they cost one franc per kilo, or 1 fr. 40c.; the bi-chromate of potash comes to 3 fr., 60c.; and the sulphuric acid (0.20c. per kilo) to 1 fr. 44c.; giving a total of 6 fr., 50c., or somewhat more than one franc per hour, and per lamp. Nor is the wages of the person in charge included. It is necessary to state that the battery can not be left neglected during several hours; the zinc must be immersed deeper at the end of an hour and a half, so as to maintain a steady current, and this operation must be frequently repeated to the last. The current always decreases after four hours' running, falling from eight to five ampéres, and is then no longer sufficient.

The bi-chromate of potash battery is, therefore, only adapted for illuminations *de luxe*, and even then on condition that they be not of long duration. On the other hand, gas, with proper burners and glass chimneys, will give an illuminating power of two carcels (16 candles), with a consumption of 180 to 200 litres, and will cost only 36 centimes for a light quite as good as the six incandescent lamps, and minus all the trouble of the battery.

In fact, incandescent electric lighting cannot compete with gas, except in establishments where the motive power is at hand. In that case, some fifteen or twenty lamps, of 8 candles, can be put up at a cost of 1,200 francs, and the cost will not exceed two centimes per lamp per hour. In the paper mill, near Grenoble, and in the workshop of M. Lazare Weiller, at Angoulême, lamps have been put in under these conditions, and have proved perfectly satisfactory.

The first plan for supplying electric light and power in cities, has been submitted to the city councils of Nantua and Bellegarde, by M. Emile Reynier. These cities have been selected, owing to the water power in their vicinity, the possibility of using ærial conductors, and the small extent of the cities themselves.

But this is an *ensemble* of favorable conditions that is rare to find in this country. In applying for a concession M. Reynier placed the price for the city for 1000 kilogrammetres at *one tenth* of one centime—or 27 centimes per horse-power of 75 kilogrammetres, and at double this (54 cent) for private parties. The consumption would be calculated by a metre, constituted by an electro-chemical bath. Under these circumstances, a light equal to one carcel (8 candles), would cost with the vacuum incandescent lamps, 2 centimes per hour for the municipality, and 4 centimes for private parties. The contractor confines himself to selling electric energy—and not busying himself with the question of its use either for lighting or work.

It is likely that accumulators, charged during the day, will have to be used to insure regularity of service. It has to be seen likewise, whether the counter or metre will be placed before or after the accumulators, for on its position will depend the rate finally paid by the consumer. The carrying out of this project will be looked forward to with interest by electricians.

Since the applications of electric light have become so numerous, the want of improving the photometric methods has become urgent; and it is especially necessary to have a luminous standard that will allow of a reliable comparison with the light furnished by gas. The question was discussed at the International Electrical Exhibition of Paris, in 1881, but it was not settled, nothing more being done than to recommend the use of the Carcel lamp according to the rules of Messrs. Dumas and Regnault. The conference of electricians that met in Paris in 1882, recommend for a luminous standard the surface of 1 square centimetre of platina in fusion. M. Violle has made some very interesting experiments on the radiation of silver in fusion, and intends to follow them up with some on platina. But, whatever may be decided on by the committee, the process will be too delicate of application to suit industrial purposes.

It is likely that each country will want—were it only through *amour propre*—to keep its own standard. France, the carcel lamp; England, the spermaceti candle; Germany the paraffine candle, &c. It would be, therefore, of the greatest benefit to determine the relative values of the various types of light, since the luminous intensities of the electric light are expressed by different figures in the various countries. A well-known engineer, connected with the gas industry, M. Mounier, has carried on a most complete set of experiments to this end. He compared the English spermaceti candles, burning under the same conditions as used in photometric tests for London gas, with the Carcel lamp; and also, with this latter, the German paraffine candle as adopted by the German gas companies; and the

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stearine candle as used in the official gas tests in Munich. He finally compared with the Carcel the ordinary candle called *Etoile*, or star, of which frequent mention is made in the contracts between French municipalities and the gas companies.

He found that the normal Carcel lamp, using 42 grams of colza oil per hour, corresponds to

8.3 English spermaceti candles,
7.5 German paraffine candles,
6.5 Munich stearine candles,
7.4 "Etoile" stearine candles, of 5 to the package,
7.6 "Etoile" stearine candles, of 6 to the package.

To show how annoying such variations are, it will be sufficient to say, that the gas, of which 105 litres in Paris would be equal to the carcel, would be equivalent to 13.5 candles according to English calculation, and 14.5 candles according to the Berlin standard.

It would be a great benefit, therefore, to the lighting interest in general, to have an international standard altogether independent of the Carcel lamp and the candle, with the numerous errors connected with them. Mr. Methven and Mr. Vernon Harcourt have been trying to find a solution to the delicate problem. According to M. Mounier, the arrangements suggested by Mr. Methven do not give sufficiently steady results for their adoption, but the use of carburetted air by means of Volatile carburet of hydrogen extracted from petroleum, and with a proper burner, as indicated by Mr. Vernon Harcourt, would fulfil every requirement. It is advisable, therefore, to have an understanding between the English, French and German gas companies to test this last named standard thoroughly, and to recommend its adoption. The American gas companies who have been enabled to appreciate the skillful experiments of Mr. V. Harcourt, will not remain indifferent to such a reform, and thus an international standard could be created which would answer until the *savants* agree as to the selection of the luminous source.

PH. DELAHAYE.

MUTUAL DISTRICT MESSENGER COMPANY OF BOSTON.

AT the annual meeting of this company, held at Boston, Saturday, May 19th, the number of directors was increased from five to nine, and the old board of the Mutual District Company of Boston re-elected: James M. Prendergast, of Francis E. Bacon & Co.; Parker C. Chandler; Henry W. Pope, of New York; D. J. Hern, Supt. of M. U. Tel. Co.; Allen S. Weeks, of Geo. Wm. Ballou & Co.; and four nominated by the Western Union Telegraph Company, as their representatives on the board, were also elected: Frederick L. Ames, a director in the Western Union; D. H. Bates, Vice-President of the Western Union; W. C. Humstone, and C. A. Tinker, Superintendents of the Western Union.

Mr. H. W. Pope resigns the general management, which he has held since the organization of the Mutual Company, and is succeeded by Mr. D. J. Hern. The contract for the exclusive collection and delivery of telegrams of the Western Union Telegraph Company in the city of Boston, covering a period of ten years, was executed.

The new company will immediately proceed to develop and extend its system by opening new offices and consolidating others.

The capitalization of the company, under the new arrangement, is $250,000, $100,000 of which goes to purchase the old company, and to secure the ten year contract; and $50,000 in the treasury, to develop and increase the plant of the company. The treasury stock is to be disposed of at par to the stockholders.

ON THE MIXTURE OF SIGNALS IN TELEPHONIC SYSTEMS.

BY M. G. ESSIG, IN THE *Journal Telegraphique de Berne.*

I EXPRESSED my opinion in a previous article, that the part of a telephonic system, which by its nature, position and functions, combines the elements that engenders mixtures, is the network of conducting wires which are animated by the influence of terrestrial magnetism, and by the effect of the continuous shocks which they undergo. I drew the conclusion that variations of magnetic intensity are produced by the working of the telephones, not only in the apparatuses themselves, but also in the conducting wire which connects them, and that these variations are transmitted by magnetic induction, from one conducting wire to the other wires in the network, and, consequently, put in activity the apparatuses served by these latter. Although experiments would seem to indorse this explanation of the phenomenon, especially, in so far, as the "mingling" is perceptible at the central office and the extreme stations of the telephonic line, yet this forms no proof that the magnetism of the conducting wires is the principal cause of the phenomenon. I will endeavor to demonstrate this by an instance from a public line of the German network, which would seem to prove that the cause must be attributed more to the way in which the central bureau is fitted up, than to the conducting wires. For the sake of clearness, I shall, first of all, describe the arrangement of the central office.

The lines joining the telephonic stations with the central office, terminate in the latter in the electro-magnets. The current of the pile that is emitted by a station in the conducting line, traverses the spires of one of these electro-magnets, excites the attraction of the armature, and causes a tongue to fall, which gives an audible and visible signal in the central office. To enable the employé to receive the calls of the subscribers at any time, it is so arranged that one electro-magnet, or both, are continually interpolated in the circuit, even when two stations that are connected together at the central office, correspond between one another. If, in order to understand this phenomenon, we compare the construction of this apparatus (the Siemens' telephones are used for transmission and reception) with that of a tongued electro-magnet, we shall find that the principal organs are alike, and as a consequence of this conformity, the same causes will produce the same effects on both. Now, if the telephone and the electro-magnet are interpolated in one and the same circuit, we shall have, under the influence of the telephonic action, identical effects on the two apparatuses with respect to the magnetic condition, and, in fact, the words that are articulated in the telephone should be immediately perceptible in the tongued electro-magnet.* But the effects produced by the telephonic working of a line, are not restricted to the apparatus interpolated in that line. On the contrary, they are transmitted by the effect of magnetic induction, from the electro-magnet in the central office—on which they are directly produced—to the other electro-magnets. But those of the latter that are interpolated in a line, communicate them in turn to the telephonic stations where the receivers are put, more or less inaction, according to the local conditions.

According to this idea of the phenomenon of the mixture of signals in the receivers, and of which it is difficult to contest the theoretical truth, this mixing must be attributed to the method in which the central bureau is fitted up—that is, to the reciprocal action of tongued electro-magnets. Technical science must, therefore, find one of the following solutions:

"Either to take measures to deaden the effect of such influence to such an extent, that it will be no longer detrimental to the working of the system; or to make such a selection and arrangement of the plant, that its working will cease to be a cause of disturbance."

The disturbing effects of the magnetic induction on the receivers of the telephonic stations might be deadened, to a certain extent, by making use of a carbon transmitter, and having a telephone without magnet or iron membrane for signal receiver. It is doubtful, however, whether a successful result could be thus obtained; if these mixings are to be completely done away with, then we must also get rid of the electro-magnets and, with them, the tongues in the central office, and have other devices for calls that will not be, in themselves, causes of mixture.

An arrangement by which the calls of subscribers would be re-produced in the central office by means of electric light, and without any aid of electro-magnets, might prove a solution of the problem.

* The question whether the ear is sufficiently sensitive to perceive this, need not be considered here, for the contrary phenomenon, viz.: that words pronounced above an electro-magnet, and even a conversation in the central office, may be heard at the end station, is a well-known fact.

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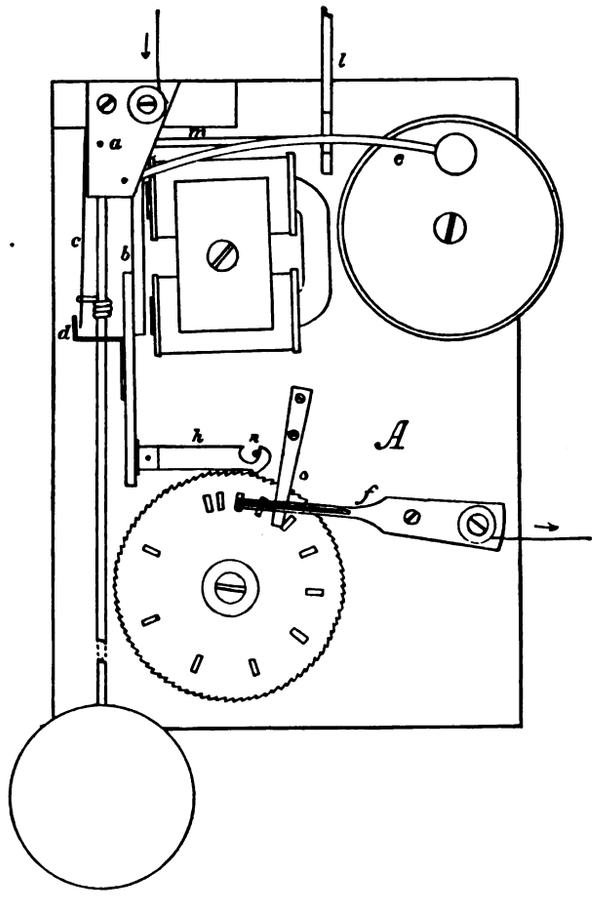
AN ELECTRIC HOUR STRIKER.

To the Editor of the Electrician:

I SEND this description of an electric hour striker after a successful trial of three months. It is a clock attachment set in motion every hour by a cam on the centre arbor, in the same way as a striking train, for which it is a substitute. The number of strokes is regulated by an automatic switch, and the circuit closer is a pendulum; the whole being arranged as follows upon a board (see diagram) *A*.

The pendulum is hung upon an ordinary clock arbor, which is pivoted at *a;* it is about ten inches long. By its side upon another arbor hangs the armature *b*, of an electro-magnet. To the pendulum arbor is fastened a piece of watch spring *c*, which is so arranged as to come in contact with an insulated pin *d*, attached to the armature, when the pendulum swings to the left. By this motion the circuit is closed, and the pin on the armature gives an impulse to the pendulum towards the right by means of the spring. The spring now moves away from the pin and the circuit is opened again. In this way the circuit is closed once every second until opened in another place by the switch.



The spring *f*, presses upon the face of a ratchet wheel having ninety teeth. When the armature moves to the right, a pawl *h*, attached to it catches over a tooth, so that when the circuit is opened by the pendulum spring the wheel is carried forward one tooth. In the path of the end of the switch spring, twelve holes are cut through the wheel, at such a distance apart that when the proper number of blows has been struck, a hole is brought under the end of the spring and the circuit opened. The spring *f*, is then supported by the piece *o*. A hammer *e*, attached to the armature arbor strikes upon a bell; its weight is sufficient to carry the armature with its attachments against the stop *n*, besides turning the ratchet wheel. I have omitted in the diagram the stop which prevents the wheel moving more than one tooth at a time. The current passes through the apparatus from the pendulum spring to the pin upon the armature, thence through the electro-magnet to the ratchet wheel, and out by the switch spring; the different parts being suitably insulated. Electric tap-bells can be placed in the same circuit with the hour striker and the blows repeated upon them. Three cells of Leclanché are sufficient to work the apparatus and one tap bell, at a distance of seventy-five feet.

During the ten minutes just before each hour, the clock raises the rod *l;* a notch in this rod engages both the arm *m*, attached to the pendulum arbor, and the hammer wire. In this way it carries the pendulum and also the armature towards the right, the latter hooking its pawl over a tooth of the wheel. At the hour both are let go. The armature carries the wheel forward one tooth, and closes the circuit at the switch. The pendulum then closes the circuit at the armature pin, and the first blow is struck. After the last blow, the pendulum spring strikes the pin two or three times before it comes to rest; but, since the switch is open, no blows are struck upon the bells.

FRED. W. STONE.

SOMERVILLE, MASS., May, 1883.

To the Editor of the Electrician.

IN an excellent article upon "The Prospects of Electric Lighting," in your April number, you say: "The most serious obstacle to the economical generation of electricity by dynamo-machines, is the extremely low efficiency of the steam engine as a means of converting heat into mechanical work." This is perfectly true; but it does not seem to be well understood by practical men, and your article does not touch upon the fact, that this low efficiency is not chargeable so much to imperfections of the engine as to natural conditions, which render a large portion of the loss inevitable, even in a perfect engine.

In the science of thermo-dynamics, it is demonstrated as clearly and rigidly as any physical law can be, that in the conversion of heat into mechanical work, a certain proportion of the heat taken from the source must, from the nature of things, be given up by the engine as heat to the refrigerator or condenser. The heat which even a perfect engine must reject unused, is to the heat that is received, as the temperature of the refrigerator, upon the absolute scale, is to the temperature of the source. To illustrate: Suppose a condensing engine, working with a boiler pressure of 80 lbs. per square inch, corresponding to a temperature of the source of 310° Fah., and having a condenser maintained at a temperature of 80° by the same scale; these temperatures, upon the absolute scale, are, respectively, 770° and 539°. Now, according to the law of thermo-dynamics, this engine, even if perfect, must give up to its condenser $\frac{539}{770}$ of the heat it receives from the boiler. It can, therefore, convert into work only $\frac{231}{770}$, or thirty per cent., of the heat it receives. An engine, therefore, which, under the conditions assumed above, converts into work eighteen per cent. of the heat given it, has an efficiency of sixty per cent., since it performs $\frac{18}{30}$ as much work as could a perfect engine. In the best steam boilers, probably twenty-five per cent. of the heat is lost in the furnace, leaving only seventy-five per cent. available by the engine; of this, under the conditions assumed above, only thirty per cent., or 22½ per cent. of the whole, can, in the nature of things, be converted into work. If, then, the engine actually converts into work eighteen per cent.

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of the entire heat generated in the furnace, its own efficiency, considered apart from the boiler, is 11.5, or eighty per cent. I believe our best engines are giving nearly, if not quite, this percentage of the work obtainable from heat under the practical conditions of working, and they are, therefore, not such very inefficient machines.

In saying that the efficiency of an engine is sixty or eighty per cent., of course the word is not used in its usual signification, as the ratio of work performed to the mechanical equivalent of the heat used, but as the ratio of work performed to the work which could be performed by a perfect engine. It seems to me proper to use the word efficiency in the latter sense when reference is had to the imperfections of the engine.

The same law of thermo-dynamics applies to the conversion of heat into electric energy. Indeed, in any conversion of heat into other forms of energy, under the conditions that exist here on the earth, nature demands that the larger share of the heat put into a machine shall be given up as heat to the cooler bodies that surround it. The conversion of heat into electric energy, directly, can, therefore, save only a small part of the loss that now occurs. But if some way can be discovered of converting the chemical energy of fuel into electric energy, without first producing heat, it will be possible to obtain from a pound of coal four or five times the energy now available by our best steam engines. What we must look for, to stop this great waste of energy to which we are now obliged to submit, is the discovery of some solvent for carbon, or some means by which coal can be used, in the place of zinc, in our galvanic batteries.

When we can shovel coal into a galvanic cell, and see it gradually waste away, producing electric energy, and not heat, the steam engine will pass out of existence; grates, stoves, and furnaces will be banished from our houses; gas for lighting will be forgotten, and the life of our coal fields will be lengthened five times. Who shall make the great discovery? W. A. A.

ITHACA, N. Y., May 15, 1883.

CERTAIN magneto-electric machines are reversible; that is, a current from one will run a similar machine in the reverse direction. It does not follow that the second machine becomes an economical electric engine. I compare a second magneto-electric machine to a water wheel, driven in its opposite direction, used for a pump.

I wish some one would make the following experiment, and publish the result: The electric engine should be partially made on Page's plan, using an iron core, which is attracted into a hollow helix. The latter should be surrounded by an iron tube. The core and tube are attracted in the direction of the helix's length. The resistance of the electric engine's coils should be equal that of the coils in the magneto-electric machine. As the machines are near each other, the resistance of the connecting wires is not counted. Can we get from the electric engine more than 100 per cent. of the power applied to the magneto-electric machine? The engine may yield sufficient energy to drive the magneto-electric machine by a belt, after said machine has been started by any motive power, the latter being shut off when the machine has been set running. This would be perpetual motion.

JAMES ASHER,
Kleinburg, Ont.

May 12, 1883.

— THERE ARE SOME four hundred applications for improvements in electrical devices waiting examination and report at the patent office.

A DEFENCE OF GAS.

NEW YORK, May 18th, 1883.

Mr. Editor:

ELECTRIC light does not increase the temperature, nor vitiate the atmosphere; this radical defect is not shared in by gas, which may ever be relied upon as the relentless enemy of pure. fresh air. During the summer months this fact is particularly noticeable, and can be vouched for by myriads of unfortunates, who have to work by gas light. Their offices resemble Turkish baths; clothing is a burden to the flesh; and a state of perpetual perspiration their happy lot. No fuel is required where they labor, for gas is an admirable substitute; it is, indeed, their warmest friend. Electric light, on the other hand, wherever used, preserves a healthful, equable temperature.

Electric light dispenses with many of the ills to which gas-lit humanity is subject; it burns steadily without a perceptible tremor, and sheds a soft and refreshing light. Shortsightedness is not engendered by its use, and headaches are unknown in its neighborhood.

Visit any large office where gas is constantly used, and you will be charmed with the variety of spectacles worn on all sides; in fact, gas cannot be relished unless gazed at through goggles; the naked eye is dazzled, and fails to appreciate its never-ending flicker and dance.

There is something extremely sensational about gas that electric light cannot lay claim to. Almost daily, the papers recount the experience of country folks, who, visiting the city, are for the first time on familiar terms with gas in their bedrooms. Retiring for the night, in all innocence, they not infrequently blow out the light, and are fortunate, indeed, if they are awakened on this side of eternity, in the morning.

Electric light here again suffers by comparison, for even the rural visitor, though he have the lungs of Boreas, is unable to blow out electric light; he can rid himself of its presence only by turning off the key which regulates the current.

Electric light is eminently safe to use, and the public encounter no danger from it, whether in bedroom, public building, steamboat or rail car. Gas, however, rejoices in a peculiar and uncontrollable power; its advantage in this respect can be often noted in explosions, when invariably human lives are forced to admit, with their last breath, its terrific power.

Gas evinces a decided partiality for certain professions and trades. Where is the householder bold enough to deny that many a time, and oft, he has been annoyed by escaping gas, and who will assert that the plumber is not in mysterious collusion with the plague, to which he owes his very livelihood.

Remove gas, and substitute electric light, and spectacle makers and oculists will fly the country or starve.

Ask your doctor, how much of his practice he owes to this health-destroying agency, and he will plead, you are having a gas(tly) joke at his expense.

There is not an hospital throughout the length and breadth of the land, but will raise its feverish voice against gas, and many a cot contains sad evidence of its deadly influence. L. K. O.

NEW YORK, May 17, 1883.

Messrs. Williams & Co.:

Gents—In the ELECTRICIAN, you give our capital $250,000. It is $1,000,000.

Yours truly,
THE STANDARD E. L. CO.

Our information was derived from an official source, which gave the last annual report of the companies.—ED.

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ELECTRIC STORMS.

To the Editors of The Electrician:

GENTLEMEN—It may interest some of your readers, to hear the result of a few rough observations made upon the telephone lines of the Westchester Company, at Yonkers, N. Y., during the famous electrical disturbance of November 17th and 18th, 1882. Although the matter has been fully discussed by the electrical engineers, both here and abroad, yet it is quite impossible to collect too many facts concerning these, as yet, unexplained phenomena. Therefore, I present these to you, in hopes they may be worth considering. Owing to the scarcity of reliable statistics, it is impossible to say whether these so-called earth currents, or electric waves, which envelop, at times, the entire globe, are due to the direct action of the sun, considered as a highly electrified and electricity producing body, or indirectly by causing atmospheric disturbances upon the earth's surface. The instruments used at Yonkers were: a rude galvanometer, consisting of a compass, mounted in a coil of twelve ohms' resistance, and having a diameter of 13 inches, and a common Bell telephone and transmitter. The first indications of an electric storm were on the morning of November 17th, 1882, at 4:30 A. M.; the operator noticing the annunciator's falling, sometimes all at once, as if by lightning, and at others singly, as if only one line at a time was charged with a current. The first observations were made upon a trunk line, six miles in length, running four miles East North-east, then two miles South and East from Yonkers. This wire was selected because the current upon it seemed to be much stronger than upon the others. The above galvanometer was inserted between the line and the switchboard of the Yonkers exchange. At once it indicated a current, giving a deflection of 150°, traversing the line from West to East. In 68 seconds it reversed its direction, giving a deflection of 150°, with a current from E. to W. These alternating currents continued to pass over this line for many hours, during which time a telephone and transmitter were thrown into circuit, the telephone being held to the ear, while the observations were read off from the galvanometer, to ascertain whether these reversals had any effect upon the telephonic condition of this wire. This wire is always a noisy one, passing, as it does, for a short distance, near telegraphic and other battery lines, and also is disturbed by earth currents, and "induction."

The following facts were established, by a large number of observations: 1st. That when the change in the direction of the current occurred, no sound was produced upon the telephone, other than those above mentioned; 2d. That when the deflection, no matter how great, indicated a current flowing from West to East, no change, other than a slight augmentation of the usual sound, was produced. But, without exception, whenever the galvanometer indicated a current passing from East to West, with a deflection of 170°, all sounds ceased, and not only was the line entirely free from the usual sounds, but was absolutely silent, and conversation could be carried on with the Mount Vernon office (during this period of silence) with very great ease, the articulation being much clearer than at ordinary times.

Starting with a deflection of 150°, indicating a current from West to East, and the line in a noisy condition, the needle would slowly swing back to zero, then over the other side, indicating a current, in the reverse direction, of 120°. At this point the noise would begin to lessen, and continue to lessen, until 170° was reached, when the line, as we have said, became perfectly silent.

This strong easterly current seemed to have the effect of neutralizing all the minor intermittent currents common to this line. If this were due solely to a strong current upon the wire, it would seem possible to produce a like effect by the use of batteries; but, thus far, all such experiments have failed. Thus, it seems as if this silence must be due to a state of uniformity in the electrical condition of the earth and atmosphere in the neighborhood of the entire length of this line, and to a state of temporary equilibrium, only possible under the peculiar conditions produced by an electric wave of vast magnitude, or—as actually does occur a few times a year (generally at night), when a state of silence upon telephone wires is produced—probably resulting from a much more local cause than the storm of November 17th.

This disturbance was not continuous in its effect upon the telephone wires of Westchester county. Beginning on November 17th, at 4:30 A. M., it steadily increased in force until 10 A. M., when it reached its maximum of strength. Then it began to decrease in force until 1:30 P. M., when it disappeared until 7:30 P. M., when it again became quite violent, lasting until 2 A. M. on November 19th.

The area of which we are speaking, is a tract of country extending 32 miles north of New York city, and lying between the Hudson and East Rivers, and Long Island Sound, and having an easterly and westerly wire length of 7 miles. Similar observations were made upon other wires running in all directions, but in no case was the force as great as upon the easterly and westerly wire of 6 miles in length; neither was the production of silence so marked as upon this wire. The next strongest currents were found upon a line, 16 miles long, running due North from Yonkers. The reversals upon these lines occurred sometimes rapidly, and at others very slowly, and, in almost all cases, the needle moved spasmodically, as if the changes in force and direction occurred by pulsations. In all cases, the lines running East and West gave an opposite deflection from those running North and South, all changing their current direction simultaneously. In speaking of these currents, the terms + and — have been avoided, because, as has just been shown by Mr. W. H. Preece, F. R. S., unless some standard, other than the current direction of a battery, be used in observing these "earth currents"—such as the polarity of a current traversing the meridian of Greenwich from South to North,—it is impossible to distinguish a + current, passing from a point of high potential to one of low, through wires running in a parallel direction, or, in fact, in any direction by which they make an angle less than a right angle with each other—from a — current; for, in such a case, the currents appear to move in opposite directions upon the two wires. We simply cite this as an example of an extreme case. In fact, however, it is impossible to determine the polarity of one of these earth currents upon any two lines, no matter in what direction they are built.

In closing, let us urge upon telephone companies the necessity of doing all in their power to secure systematic observations of these electrical disturbances, and also of the minor currents so common upon their wires. It is in their power to add the most valuable information obtainable upon this very obscure matter; for they have wires running in every direction, and, unlike the telegraph companies, observations can be carried on while the wires are in use. It would be hard to predict what might not be the money value, to telephone companies, of a careful and systematic set of observations of this kind. It has been suggested, that lines should be constructed, in connection with our astronomical observatories, for this purpose; but no observatory could afford to construct such a system of observation wires as are possessed by our telephone exchanges; so that all that is necessary, is to connect the laboratory of the

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observatory with a central telephone office, by one or more wires, when observations could be taken, many times a day, upon wires of almost any length or direction, without inconveniencing the telephone companies in any way, and might lead the way solving the present difficulty of telephoning long distances.

I remain, gentlemen, your obedient servant,

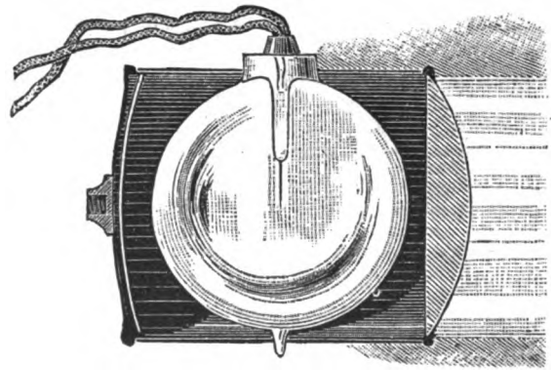
W. R. CABOT.

YONKERS, May 17th, 1883.

HÉLOT AND TROUVÉ'S FRONTAL ELECTRIC PHOTOPHORE.

THE frontal electric photophore, presented by Dr. Bouley to the Paris Academy of Sciences, and by Mr. Dujardin-Beaumetz to the Paris Academy of Medicine, in their sessions of April 16th and 17th, 1883, *L'Electricite* says, is a happy application to medical uses of incandescent electric lamps, *in vacuo*. Previously, it had been found impracticable to employ these apparatus, save on a large scale, and by working them with the aid of powerful dynamo or magneto-electric machines, or with accumulators charged by the same.

Mr. G. Trouvé, by making an important improvement in the bichromate battery, has made it possible to utilize this wonderful illuminating agency, for domestic purposes. Outstripping all competitors, he has made this light available for all, whereas, before, it appeared to be suited only for large manufactories, and other considerable establishments, that need not fear the expense of a costly plant.



Dr. Paul Hélot, surgeon-in-chief of the hospitals of Rouen, and Mr. Trouvé, have solved, in an equally satisfactory way, the problem of medical electric lighting. Their apparatus consists of a vacuum incandescent lamp, contained in a metallic cylinder, between a reflector and a focusing lens. This photophore, which is very light, and of but little volume, is applied to the forehead, after the fashion of the mirror employed by the laryngologist, or the aurist. The light furnished by it is very strong. A slight change in the position of the lens, alters the field of illumination with the greatest ease. Placed in the axis of the eyes, the light accompanies, so to speak, the eye of the operator, and he need have no concern about the management of it. In case it be deemed better to use the apparatus without having it attached to the forehead, it might readily be fixed to a support, resting on a table, on the arm of a chair, or any other piece of furniture.

The source of electricity is the Trouvé's battery of supersaturated bi-chromate of potassia. This will serve for several hours, either continuously or at intervals, without needing to be renewed.

This powerful electric light apparatus may be employed in a multitude of cases, where there is need of illumining the field of a surgical operation, lying deep in the natural cavities of the body—as the mouth, throat, ears, etc.

Gynæcologists will often have occasion to employ it in certain delicate operations, where plenty of light is required. But it is especially in diseases of the larynx, and of the ear, that it seems likely to supersede all other apparatus; for the light it supplies is perfectly white, and in no wise changes the color of the tissues.

Henceforth, dentists will not be content to work their White's excavator by means of the battery and Trouvé's motor; they will be enabled, without materially adding to the cost, to illuminate, thoroughly, the cavity of the mouth, by means of the electric photophore.

The apparatus is both ingeniously contrived, and made in a workmanlike way, and with scientific precision. It is destined to find favor with physicians.

SECONDARY BATTERIES.

SECONDARY batteries, says the *English Mechanic*, or rather patents for them, are becoming as numerous as galvanic cells themselves, and the number of known combinations is very large, though an enumeration of those in practical use would not occupy much space. Probably, descriptions of secondary batteries already in use would not occupy many volumes, but certainly a mere list of the patents recently taken out for modifications of the Planté cell would occupy a column or two. There is, it must be confessed, a family likeness amongst nearly all of them, and it may be safely surmised that the patent office will reap the chief benefit, from a pecuniary point of view. One of the most recently patented, and most promising devices is that known as the B.T.K. cell, from the names of the patentees, J. S. Beeman, W. Taylor, and T. King, of Cannon Street, E.C. This invention relates to the formation of plates for electrodes, made of insulating tape-like materials in combination with suitable metal ribbons; also of insulating tapes covered with metal, in combination with an insulating ribbon, tape, or strip alone, or so used as to form a carrier or vehicle for salts of lead, or lead in a finely divided condition, such insulating carrier being sandwiched, so to speak, between the metallized ribbons, or their substitutes. The insulating carrier and metal ribbons may be made in any convenient manner, and may be corrugated longitudinally and transversely. The insulating strips are coated with the powdered and inert material on one side, and with salts of lead on the other. Part of the invention also refers to plates formed as above, and used in combination with an improved cell made of wood, soaked or coated with paraffine, lined with a cell of paper, treated with paraffine, and having a layer of paraffine interposed between the wood and paper cell. Sometimes an extra partial casing of sheet iron is used outside of the wooden one, with an interposed layer of paraffine wax. Part of the invention further relates, in combination with above improvements, or some of them, to a mode of connecting the different sets of plates together, so that any one plate may be easily removed; and the formation of a hook attachment for connecting the cells together, together with an improved valve for ventilating the cells; also, in combination with the improved plates, part of the invention relates to an improved mode of applying studs, rods, tubes, or equiva-

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lents (either alone or in combination with rings), to support and keep in position, together and apart, the plates—the studs, rods, tubes and rings being made of any convenient non-conducting material, such as glass, porcelain, vulcanite, or of metal or wood covered with non-conducting materials The invention refers, in combination with the improved cell, to the use of an insulated tray or stand supporting the cell, and for holding oil to prevent return current by earth. The claims in this case are for the construction substantially as described. Another device, which, however, proceeded no further than provisional protection, is that of Dr. Aron, of Berlin, in which the invention consists in impregnating capillary substances with a lead combination, and winding them on the polar plates. The capillary substances may be first stitched on lead plates, and subsequently impregnated with the active compound, and the polar plates may be of dialysing substances perforated, the outer wrappings being of wool, straw, or wickerwork Another patent is one to C. T. Kingzett, London, and relates to the form of the electrodes, as well as to the compounds used. The patentee prefers electrodes of a brush-like form, in which the "bristles" are hollow, and with the "back" are in one piece, which is inserted into the lead compounds. From practical investigations the patentee concludes, that while red lead may be usefully employed at the electrode, at which oxygen is set free during the charging process, it may be replaced with advantage at the other pole, by the sulphate, chloride, or oxychloride of lead; or, better still, a freshly prepared mixture of litharge and dilute sulphuric acid. Hydrochloric acid may be used as an electrolyte, and it is preferred to charge the cells in one direction only. The patentee refers to calcic hypochloride, as an agent for prolonging or revivifying the action of secondary batteries, and for securing free access of the electrolytic fluid to the various parts, uses pieces of tobacco pipes, wicks of porous material, &c. A patent obtained by J. E. T. Woods, London, strikes out a new line, for in this case the electrodes are made of carbon, or alloys of chromium and iron, or "other suitable metals," and are covered with a layer of an oxide of chromium, occasionally mixed with a little chromic acid, and retained in position by a covering of asbestos fabric, woven spun glass, or a diaphragm of porous earthenware. Chromic acid and protoxide of chromium are produced by the charging current. The patentee says, that permanganic acid as a permanganate and suboxide of manganese, or an oxide of copper, may be used with suitable electrodes, instead of the oxides of chromium. M. Somzée, of Brussels, has also obtained a patent, one part of which relates to a method of applying minium to lead plates by securing it with some agglutinative substance. Another part describes a paste made of minium and powdered pumice, which admits of thorough penetration of the acid and current; and the pumice absorbing the acid, the battery is rendered dry. M Somzée also uses a light and porous coke, the interstices of which are filled with lead, by first soaking in a solution of the acetate, and reviving the metal by heat, and then pressing minium, or other suitable metallic preparation, into the pores. That object is effected in other ways—e g., by mixing the pulverized minium and coke with sugar or other agglutinative matter, and heating the slabs so formed in such a manner, that while the metal is obtained in the desired state, the block is kept as porous as possible. Such are a few of the recent ideas in connection with the formation of secondary batteries; but it may be doubted whether any of them are better than the simple Planté form, when that has been brought into its best working condition.

—— MR. EDISON, and others, filed papers, on May 7th, with the Secretary of this State, incorporating the Electric Railway Company of the United States; capital, $2,000,000. The Molecular Mutual Telephone and Telegraph Company was also incorporated, same date.

—— M. FOUSSEREAU has lately measured the electric resistance of glass by charging a condenser from a known battery through a given thickness of the glass, and observing the time required to raise the potential of the condenser to a given degree. Bohemian glass was found to be from 5 to 20 times as good a conductor as ordinary glass, whilst flint glass was from 1,000 to 1,500 times as good an isolator. M. Foussereau found also that annealing the glass increased its resistance, in some cases eleven-fold.

TYPES OF LUMINOUS ELECTRICAL PHENOMENA.

BY DR. W. HOLTZ.

In Zeitschrift für Angewandte Elektricitätslehre.

(Translated for THE ELECTRICIAN.)

I HAVE treated, in previous articles, of the various phenomena of light, which an induction electrical machine will give without any important subsidiary apparatus; but, I have always felt that it was exceedingly difficult to convey an idea of these phenomena by mere words I have, therefore, made an attempt lately to permanently fix their most characteristic forms, by means of pictorial representations, and beg, herein, to offer a series of those which may be classed as the so-called *one sided brushes*. The term brush, is applied to a phenomenon, that consists of numerous rays of light, that is only perceptible in the dark, whose advent is announced by a slight noise only, and which is developed between oppositely electrified bodies, especially in air media—as the effect of a quiet and continuous electric transmission. In order to create them with more certainty, the so-called condensers must be removed from the machine, and the electrodes placed at a considerable distance from each other. Brushes are termed partial, when they keep to one electrode only, or when although appearing on both, yet run in a conical shape in one direction only. They are called *positive* or *negative*, respectively, according to the kind of electricity of the electrode to which they are attached, or toward which the stem of the luminous globe is directed.

To obtain them with the greater certainty in the one sided form, we must deflect the other electrode in question, but the consequence of this is that the appearance loses in extent.

These partial brushes are very differently constituted in two respects: First, in their outer form, and then in their internal structure. Next to the nature of the interpolated medium, the kind of electricity has most influence, and then, the shape, size, and distance of the electrodes. We shall not take the first factor into consideration here, as the accompanying illustrations refer to appearances, that are obtained in ordinary *air only*. That the source of the electricity producing them has an influence, I have already given to understand; but as this factor may also be considered as of secondary importance, it shall only be treated of incidentally.

The following are the shapes and sizes of the electrodes that I used: At one time I employed the ordinary pointed ends of the discharging rods; then three different kinds of globes, viz., of twenty-five, fifty-five, and ninety millimetres; finally a hollow disc, with a semi-circular edge, that measures thirty-five millimetres in thickness, and 230 millimetres in diameter. I need not go into any further description, as each piece will be easily recognized, in the illustrations, and as everything else is drawn according to proportion.

I may mention, however, that a medium sized machine with a rotatory disc of 400 millimetres, was employed.

The positive brushes, as will be seen at once from the cuts, are always to the right, while the negative appear on the left. I have thus sketched them to make the subject clearer. It is simpler, in experimenting, to have electrodes unchanged as little as possible, and to this end to let the machine work more frequently oppositely.

Fig. 1 shows first, the positive brush with long stem and short, straight collateral lines, which are very fine and have a great divergence. With a sharp point, or feeble action, we have a weak, glimmering light instead, while a sharp point with strong action may also produce slender brushes. Very characteristic of the point, is the straightness of the converging lines, as they may also be met with in very small globes, but never with large ones.

Fig. 2 represents the small negative brush, which, under conditions, in other respects the same, forms a small ball that is likewise formed of equally straight but fine lines that fix themselves just at the top. It might be taken, on account of its smallness, for a mere glimmer, if its shape were not remarkably like that of the larger negative brush.

In Fig. 3 we perceive the large positive brush with long stem, and long, but slightly diverging, branches, which bifurcate, and are split up

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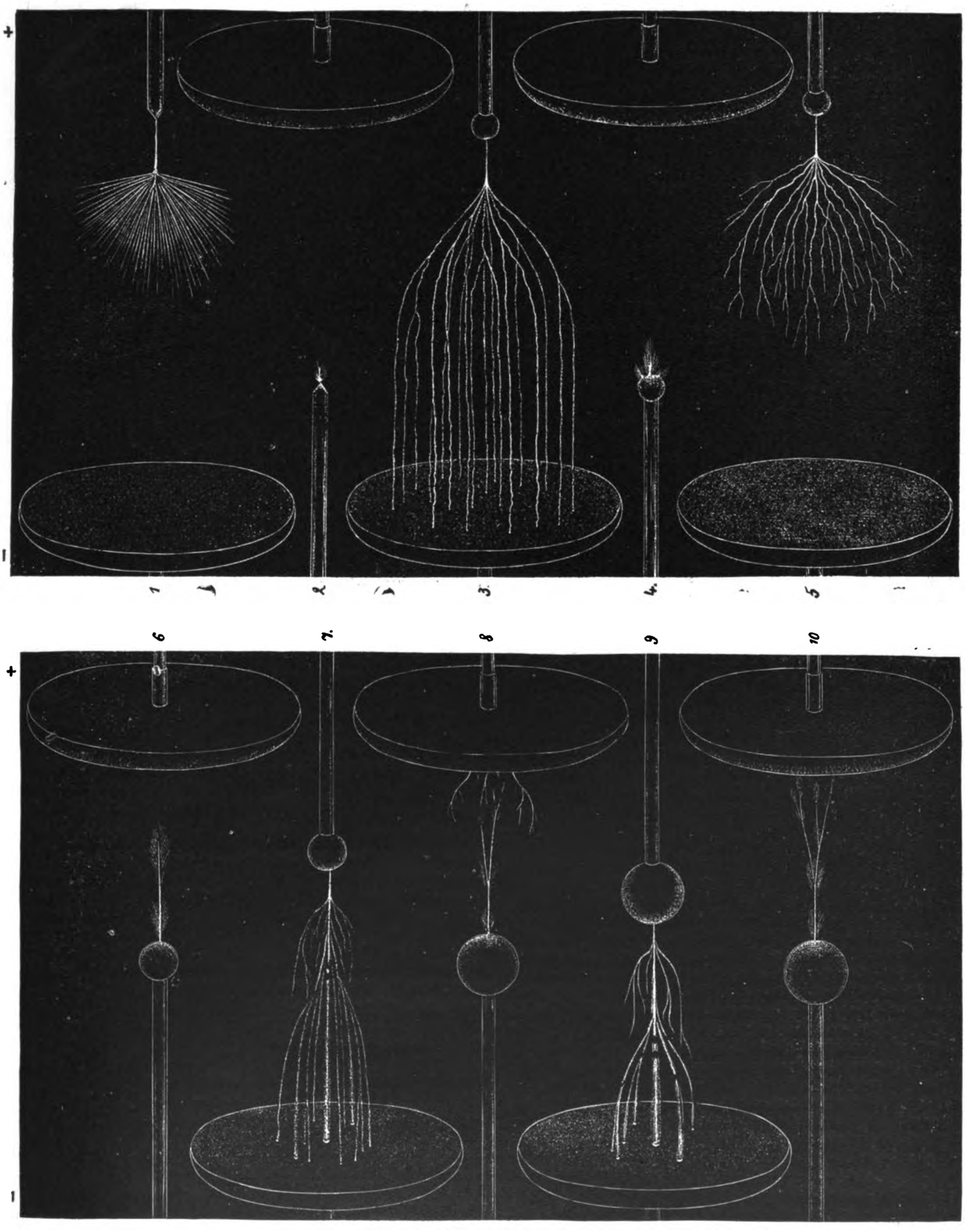

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into other branches. This tree-like, crooked, and repeated ramification, is characteristic of the action of the ball when it is held opposite the point. The further course of the branches, and the mitre-shaped appearance of the whole, is still more the effect of the hollow disc, and the circumstance that this is not derivated.

In Fig. 5 we meet with the same conditions, with the exception that the disc is derivated. If a smaller surface were in the place of the disc, this would act similar to a derivative, at least in this especial case, while otherwise, derivation and enlargment of the surface are equivalent. We see that a shorter brush, which is in shape like a tree, will be completely extinguished from time to time, while a glimmering light covers the front conic surface The intermittency with the glimmering light is less frequent with derivation, than when a smaller surface is used.

If we examine the small negative brush, under similar circumstances, in Fig. 4, we shall find that it is quite like that in Fig. 2, only that it is somewhat longer shaped. We do not meet it, however, any longer isolated, but in company with smaller ones, which is as well a distinctive difference between the ball and the point action, as between the negative and the positive brush.

It has also this peculiarity, that it adheres less persistently to a fixed point, and apparently flees from the medium line.

If we allow the brushes to grow, as in Fig. 9, the same negative brush will grow longer; but its lengthening does not occur in a simple manner—a longer brush rather grows out of a shorter one. A conical shaped, luminous brush is seen on the longer stem, while the foot of the latter is enveloped by a second and similar luminous brush. The primary effect of increasing the size of the globe, is to extend the phenomenon to a greater length, while it also receives a stem, which was not previously visible.

The increase in the globe has an almost contrary effect on the positive brush. The discs must be brought closer together, to obtain analogous appearance to those in Fig. 3. The brush, in fact, grows shorter; but a ramification in the midst of the stem, which is otherwise quite branchless, appears simultaneously as seen in Fig. 7. The shortening is otherwise balanced by a thickening—especially of the lines—which fully reach the disc. Dark spaces, which, however, are only relatively so, may be perceived in these brushes, but at a greater distance from the disc. The derivation acts rather less in these circumstances in lifting the brush from the disc; no luminous appearance is formed.

The positive brush grows continually shorter, when larger globes are employed, while at the same time, the branches tangent to the disc become thicker. At the same time the dark intervening spaces increase in number, or in size, and approach nearer to the disc, as represented in Fig. 6. The number of light lines decrease, however. Finally, the brush is mixed with bright sparks, and this is especially favored by derivation.

The negative brush, on the other hand, becomes longer, when larger globes are used. It becomes, in two respects, more like the positive, in that its stem becomes more clearly defined, and its tendency to ramification increases. But, in respect to the latter, there still remains a material difference. In the first place the ramification appears isolated; seldom is there any secondary formation; then each branch is surrounded like the head stem, at its foot, by a conical shaped sheaf of light. In such they also terminate, just as if they were isolated, self-exisiting brushes. Finally, they show only a very slight divergence. There is yet another circumstance that is characteristic of the negative brush. Its twigs cannot be made to fully reach the disc. Still, on a nearer approach, as in Fig. 8, a peculiarly formed positive brush emerges, spark-like from the disc. The entire appeaance is then, properly speaking, no longer a partial brush, but is so to the extent, that a partial brush is periodically seen. In other respects, the general rule for the formation of two sided brushes, also holds good here, viz., that brush ends never come into full contact with one another.

To obtain the long stemmed negative brush, as much as possible, by itself, a certain distance of the electrodes must be kept, which is, of course, dependent on the size of the globe and the efficiency of the machine. Very dry air is requisite, however, to have it of full length, and the room must be very dark to see it clearly. Then it will be observed, as in Fig. 10, that its separate branches are interspersed with a great number of small, dark spaces, which correspond to those of the positive brush, only that they are much smaller and more numerous.

A material prolongation of the negative brush may be also produced by using smaller globes, and covering them with thick layers of silk material.

A few well-known facts, with regard to light and color, may be mentioned, for a better comprehension of the drawings. The stem of all brushes is brighter than its ramification, and this becomes weaker in light, in proportion as it extends. Those branches, which, however, fully reach the second electrode, stop there with a relatively bright light disc. The stem is, on the average, more violet, the branches of a bluer shade; otherwise, the violet is more peculiar to the negative, and the blue to the positive brush. Those branches that do not terminate in air, but lead up to the electrode, have always a dash of violet; the violet color increases with the size of the globe, or generally with the size of the discharging surface.

So far as acoustic qualities are concerned, we find that more of a hissing hoise accompanies the negative brush, while the positive has more of a humming sound—that is, the tone of the negative is generally higher. But the tone from both brushes becomes deeper as larger globes are used, and so, it finally happens, that the tone of the negative would become a humming one if the globe used were sufficiently large. It has long been known that these distinctive noises have their origin in the slower, or more rapid sequence of incomplete discharges.

ELEMENTS OF ANALYTICAL ELECTROMETRY.

NEW YORK, April 15th, 1883.

To the Editor of the Electrician.

DEAR SIR:—In the following, I have the pleasure to submit to you an essay on the "Elements of Analytical Electrometry." It is my purpose to give a general formula, which will enable one to find the electrical resistance of any conducting surface, if its shape is given by an analytical formula. Most truly,

F. HOFFBAUER.

If in any conducting surface an electric current passes from the point A to the point B, then the lines of equal potential are circles over a diameter, the ends of which intersect the line $A\,B$ in an harmonical proportion; and the lines of forces or circles passing through A and B, with the centre on that line, which intersects the line $A\,B$ in its centre at right angle.

Supposing the surface would be bounded by two circular arcs passing through A and B, one above the line $A\,B$, the other below, both from the radius (r); and, further, supposing $A\,B=(2a)$, the thickness of the surface (m), and the X axis falling in the direction of $A\,B$, and the Y axis in its centre at right angle, then the resistance of each material equal potential line is $\frac{dx}{m, f, (x, y, r.)}$ and the resistance of the full surface is

$$p \cdot \frac{1}{m} \left| \begin{matrix} x = +a \\ \int \frac{dx}{f\,(x, y, r)} \\ x = -a \end{matrix} \right.$$

p is the relative resistance of the material.

To apply above formula to a surface [given by the formula (I) $y = f\,(x, a)$], we have to find those circular arcs above

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and below $A\,B$, and passing through A and B, which are touching the boundings of the surface given, and then we proceed as stated above.

If one curve is touching the other, they have for this touching point the same tangent, and, therefore, we have to find the co-ordinates of the touching point. The formula of the tangent is (II) $x = y\,cotg\,d + q$, where d is the angle between the tangent and the x axis, and q the piece, which the tangent and the y axis cuts out the x axis. The formula for the circular arcs $\sqrt{}$(III) $x^2 + y^2 + {}^2y\,z = a^2$, where z is the distance between the circular centre and the line $A\,B$.

Out formula (I) $cotdg = \dfrac{df(x\,a)}{dy}$

Out formula (III) $cotdg = -\dfrac{y+z}{x}$

Those results combined with formula (II) give

$$(1)\ x = y\,\frac{df(x\ a)}{dy} + q, \text{ and}$$

$$(2)\ x = -\frac{y+z}{x}y + q$$

now in (1) is $x = f(y\ a)$, in (2) $x = \sqrt{a^2 - y^2 - {}^2y\,z}$ this is sufficient to find the value of y.

Suppose, for example, the given surface is an ellipsis $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, then we have $cotyx = -\frac{y\,a^2}{x\,b^2}$ and $x = a\sqrt{1 - \frac{y^2}{b^2}}$, and therefore $q = \frac{a^2}{x}$; further, we have $-\frac{y+z}{x} = \frac{x}{y-c}$, therefore, as

$$c = \frac{b^2}{y} \text{ we have}$$

$$z = y\,\frac{(x^2 + y^2 - b^2)}{b^2 - y^2}, \text{ and further,}$$

$$q = \frac{a^2 - y\,z}{x}, \text{ therefore,}$$

$$\frac{a^2}{x} = \frac{a^2 - y\,z}{x}$$

$$y\,z = o$$

$$x^2 + y^2 - b^2 = o$$

$$y^2 + a^2\,(1 - \frac{y^2}{b^2}) = b^2$$

$$y^2\,\frac{a^2 - b^2}{b^2} = b^2 - a^2$$

$$y = b$$

This result means the circular arc touches the ellipsis on the end of its short axis (b); the diameter of the arc is

$$2\,r = \frac{a^2 + b^2}{b}$$

SPARKS.

—— THE QUEEN has knighted Dr. C. W. Siemens, F. R. S.

—— AMONGST THE EXHIBITS at the Vienna electric exhibition, will be Prof. Fleeming Jenkin's telpherage system; Ayrton and Perry's electric railway; many well-known firms with dynamos, lamps, and other appliances; and the Duplex Electric Light and Power Storage Company, with a new battery, said to yield valuable residual products. Herr Bornhardt, of Brunswick, amongst other exhibits, will show influence-machines, with 20, 30, and even 60 discs.

—— THE NEW ORLEANS *Times Democrat* gives the following "At the Brush electric light station, at the corner of Notre Dame and Front Streets, there is a dog-trap, which is somewhat remarkable, and the effect produced on prowling canines very peculiar. A space on the floor is dampened, and one wire from an electric light, connected with the spot, in the centre of which is a piece of meat, with the other wire attached to it. A dog entering the establishment, is naturally attracted by the meat, and approaches it, having to stand on the moist space. The moment he touches the meat, the circuit is made, and the intruder is thrown some distance by the shock. The other night, an Irish bulldog made four attacks on the meat, and had, after a severe shaking, to relinquish his grip on the toothsome bait. The stroke passing over the small wires used is not sufficient to kill, yet it is severe enough to impress the dogs with its force, and they rarely return."

—— THE PATENT OFFICE *News*, May 15, says: "The Examiner of Interferences will soon render a decision in the celebrated telephone case, in which Messrs. Bell, Gray, Edison, McDonough, Dolbar, Boelker, Blake, Irwin, and Richmond, are interested. This decision will involve the settlement of eleven different cases, represented by the parties above named. Originally, there were other parties in interest, but they have dropped out, or their interests absorbed by those now actively contesting. The cases have been pending since 1878, and the arguments were made before the examiner in October, 1881, more than eighteen months ago, The testimony is embraced in five large books, and the decision of the examiner will be an elaborate and exhaustive treatment of the subject involved. The examiner has gone into the matter carefully, and his decision will cover over 700 pages of manuscript. The principal point involved, is the arc of the transmitter, which Bell claims, and upon which he has been receiving, large royalty from all other companies.

—— *La Nature* says: By the following simple method, plates for telephones and microphones may be made of any thickness. One or more plates of the desired shape and size are cut out of a piece of sheet iron. After dressing, rub them well on both sides with a dry cloth; this is essential to obtain an equal thickness, as otherwise the greasy spots left by handling, would prevent a uniform action of the acid. It is better, also, to treat only one plate at a time. After wiping the plate well, it is plunged vertically, so as to be submerged in a bath of azotic acid. Acid that has been used several times in a Bunsen battery can be used, or else the azotic acid of commerce, with the addition of one-fourth of water. The plate must be taken out frequently to ascertain the thickness. When the proper thickness is obtained, the plate is well washed in water, until the coating of blackish rust or oxide has completely disappeared; it is then let dry and one or more coatings of black Japanese varnish given on both sides to prevent oxidation. In this way, plates may be obtained as thin as desired, and of all shapes and sizes. When membranes are used in microphones, this is no slight advantage.

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BUSINESS NOTICES.

NOTICE.

THE pressure upon our columns this month, compels us to defer publication of some interesting matter until our next issue.

ONE of the Commissioners of the Franklin Institute to the Vienna International Electrical Exhibition, will take charge of American exhibits, and correspond for a few American papers while in Vienna

Address CARL O. HERING,
University of Penna., Philadelphia, Pa

WANTED—Clean copies of THE ELECTRICIAN, for March and August, 1882, for which fifty cents each will be paid. Address, W. K. FREEMAN, 38 East 14th St., New York.

WANTED, by a young man of large experience (now running 58 lights), a situation with an Electric Light Company, can furnish ample reference as to ability, &c. Address, A. J. C. care of ELECTRICIAN, Room 55, 115 Nassau Street, New York.

THE WEST INDIA TELEGRAPH AND TELEPHONE CO., Limited. Capital stock, $150,000; shares, $10 each, full paid, and non-assessable. Transfer office, Long Branch, New Jersey. This company has acquired, and *owns*, all the telephonic rights, formerly the property of the Continental Telephone Co., and Tropical American Telephone Co., for the *exclusive* rights to operate on the islands of Hayti, San Domingo, Jamaica, Porto Rico, Vique Culebra, St. Croix, and St. Thomas. This company *buy* their telephones and transmitters. A portion of the stock is offered for sale.

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IT was our pleasure, a few days since, to witness the practical use of the Elgin Telephone. The line we talked over was between two residences, the voice came from the distant end, clear and loud, so as to be distinctly audible several feet away from the instrument. For the purpose intended, we think it fills the bill to perfection. We understand the Elgin Telephone is fast becoming the standard instrument, for short private lines, as we find them in the regular catalogues of our prominent electrical dealers in all the large cities. Mr. Wm. Hubbard, the inventor and patentee, is an old telegrapher, and has been local manager of the largest telephone exchange in Kane County, Ill., for several years, and naturally knows what is required in a telephone.

THE ADAMS & WESTLAKE WIRE GAUZE NON-EXPLOSIVE OIL STOVE. This stove is, beyond all question, the safest, most durable, and simplest in construction, the easiest to regulate and keep clean, and produces the most heat, in proportion to wick surface, of any stove in the market. It is the only oil stove made on which other cooking can be done while baking or roasting. This oil tank and all parts are of cast iron, save the drum and wick tubes, making it strong and substantial. The wick tubes are adjustable, making it convenient for repairing, or to remove a wick should one get into the reservoir,

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CHARLES WILLIAMS, JR.,
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BRADLEY A. FISKE,
→*Consulting Electrical Engineer,*←
59 Astor House, N. Y.
Opinions, Calculations, Estimates, etc.

BOOK NOTICES.

ALLISON'S DICTIONARY OF ELECTRICITY; cloth, 12mo., 192 pp., 96 illustrations; price $2. ALLISON'S COUNTING HOUSE DICTIONARY AND DICTIONARY OF ELECTRICITY; 576 pp., 300 illustrations; $3. STORAGE BATTERIES; 60 pp., illustrated, paper cover; 50c. The above works sent prepaid, on receipt of price. See ELECTRICIAN, April No., page 117. Address, WM. L. ALLISON, 191 Fulton Street, New York.

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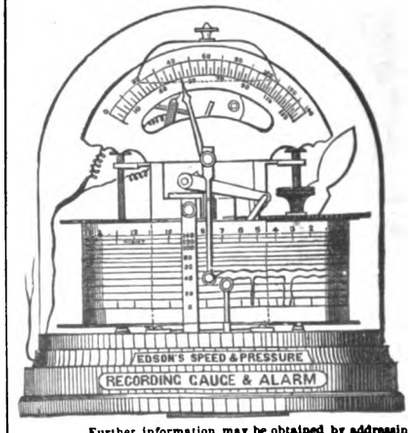
The day has passed for basing steam boiler or engine performance upon assumed bases or conditions. Pressure of steam taken from gauges by ocular observation or piston speed by counting the revolutions by watches are not close enough to give a true mean. An actual average can only be obtained by the actual record of work done for every moment of work. With this as data, the engineer can obtain more than approximate results; he will have mechanical facts as easily read by an expert as a printed page.



Edison's recording steam gauge and speed record is a new device attached to the gauge whose merits are so well established, and it achieves positive results in regard to records which is so essential to estimating the commercial value of the work of the steam-engine.

The speed recording apparatus is driven by a belt from any principal part, and shows the fluctuations from a regular velocity on the same chart as the records from the steam gauge.

Besides these features of excellence there is an alarm gong operated by a special mechanism, whereby notice is given when the limit of "high" or "low" pressure is reached, and a corresponding alarm can be sounded any distance from the gauge by the addition of an electric alarm apparatus.

Among the many mills now using the Edson Recording Gauge and Alarm are: the Social Cotton Mills, Woonsocket, R. I.; Harmony Mills, Cohoes, N. Y.; Merrimack Mills and Print Works, Lowell, Mass.; Pacific Cotton Mills, Lawrence, Mass.; Oriental Print Works, Apponaug, R. I.; Mt. Vernon Mills, Baltimore, Md.; Dolan, Cotton Mills, Philadelphia, Pa.; Passaic Print Works, Passaic, N. J.; Bitterhouse Mfg. Co., Passaic, N. J.; J. N. Stearns, Silk Mfr., New York City; Nottingham Lace Works, Brooklyn, N. Y.

Further information may be obtained by addressing the Edson Recording and Alarm Gauge Company, 77 Liberty street, New York.

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HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

SHEET BRASS, BRASS WIRE, RODS AND TUBING, COPPER RIVETS AND BURS,

Pure Lake Superior Copper Wire

FOR ELECTRICAL PURPOSES.

INSULATED ELECTRIC LIGHT

: AND :

Patent "K K" Insulated Copper and Iron Wire.

The Iron is Specially adapted for Telephone Use.

No. 49 CHAMBERS ST., NEW YORK. | **No. 506 COMMERCE ST., PHILADELPHIA.** | **No. 18 FEDERAL ST., BOSTON.**

Works at Waterbury, Conn.

G. W. HUBBELL, Pres. F. T. FEAREY, Sec. and Treas.

THE AMERICAN
Electric Storage Company.

We desire to arrange with Electric Lighting Companies, for the introduction of our batteries, and also with parties competent to organize sub-companies.

A Manufacturing Company, that will have control of our patents, to supply our Licencees with batteries, is being formed. Parties desirous of interesting themselves in this valuable invention, can see it in operation at **237 Broadway, Room 40, New York City,** under charge of **Prof. N. S. Keith.**

All correspondence received will have attention at an early day.

The American Electric Storage Company,
792 Broad St., Newark, N. J.

ARC AND INCANDESCENT LIGHT.

THE

United States Illuminating Co.

59 Liberty St., New York.

Sole Grantee of all Patents and Rights owned by

THE UNITED STATES ELECTRIC LIGHTING CO.,

for the City of New York and vicinity.

The Machines and Lamps manufactured for this Company are under patents of **Maxim, Weston, Farmer and others,** and comprise all the latest improvements in Electric Lighting.

EUGENE T. LYNCH,
President.

EQUITABLE
LIFE ASSURANCE SOCIETY.

OF THE UNITED STATES.

No. 120 BROADWAY, New York.

JANUARY 1, 1883.

(On 4½ per cent. Basis.)		(On 4 per cent. Basis.)	
Assets, -	$48,025,751	Assets, -	$48,025,751
Liabilities,	37,367,076	Liabilities,	39,949,454
Surplus, -	$10,658,675	Surplus, -	$8,076,296

RATIO of Surplus to Liabilities of the leading life insurance companies on a four per cent. basis:

	ASSETS.	LIABILITIES.	SURPLUS.	RATIO.
EQUITABLE.....	$48,025,751	$39,949,454	$8,076,296	20.21
NEW YORK.....	50,800,396	43,760,183	7,040,213	16.09
MUTUAL, N. Y.....	97,961,317	93,349,903	4,611,414	4.94

The amount of New Business transacted in 1882 by the Equitable Life Assurance Society exceeded the largest business ever done by any company in one year.

INDISPUTABLE INSURANCE
AND
PROMPT PAYMENT OF CLAIMS.

The Equitable having declared its policies, over three years in force to be **Indisputable,** will pay all such indisputable policies at maturity, without rebate of interest, immediately after the receipt at the Society's office in New York, of satisfactory proofs of death, together with a valid and satisfactory discharge from the parties in interest.

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WILLIAM ALEXANDER, Secretary.

Life Insurance Agents desiring to connect themselves with THE EQUITABLE LIFE ASSURANCE SOCIETY in which they will enjoy the greatest facilities for transacting business, may communicate with the officers at 120 Broadway, New York.

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PATENTS FOR APRIL AND MAY, 1883.

APRIL 24th.

276,216 Electric Circuit Switch Board. F. Blake, Weston, Mass.
276,228 Electric Cut-out. E. M. Avery, Cleveland, O.
276,286 Electric Cut-out. T. H. Rhodes, Brooklyn, N. Y.
276,275 Electric Generator, Dynamo. C. C. Peck, and W. H. Chapman, Middlebury, Vt.
276,194 Electric Machine, Dynamo. H. Roberts, Pittsburg, Pa.
276,190 Electric Wire Conduit. J. A. Mehaffey, Parnassus, Pa.
276,486 Electric Wires, Laying Underground. C. D. Shrieves, and J. E. Cook, Philadelphia, Pa.
276,233 Electrical Generator and Motor. T. A. Edison, Menlo Park, N. J.
276,232 Electrical Generators, Operating and Regulating. T. A. Edison, Menlo Park, N. J.
276,263 Electrical Switch Board. C. W. McLean, Newberne.
276,285 Gas by Electricity, Push-bottom and Circuit for Lighting. T. H. Rhodes, New York, N. Y.
276,390 Magneto and Dynamo electric Machines. A. I. Gravier, Paris, France.
276,274 Magneto-electric Generator. C. C. Peck and W. H. Chapman, Middlebury, Vt.
276,155 Secondary Battery. C. F. Brush, Cleveland, Ohio.
276,348 Secondary Battery Element. C. F. Brush, Cleveland, Ohio.
276,300 Secondary or Storage Battery. E. T. and E. E. Starr, Philadelphia, Pa.
276,301 Secondary or Storage Battery. E. T. and E. E. Starr, Philadelphia, Pa.
276,472 Telegraph Line, Underground. N. M. Rittenhouse, and M. W. Locke, Baltimore, Md.
276,184 Telephone and Telegraph Switches, Electric Time Register for. F. E. Kinsman, New York, N. Y.
276,465 Telephone Call Indicator. J. M. Provoost, Buffalo, N. Y.

MAY 1st.

276,739 Annunciator, Telephonic. G. L. Weaver, Boston, Mass.
276,960 Electric Call. J. B. Currier, and D. H. Rice, Lowell, Mass.
276,568 Electric Machines, Armature for Dynamo. L. Daft, Greenville, N. J.
276,953 Electric Way. E. M. Bentley, Washington, D. C.
276,954 Electric Way. E. M. Bentley, Washington, D. C.
276,757 Electric Way. E. M. Bentley, and W. H. Knight, Washington, D. C.
276,829 Electric Way. W. H. Knight, and E. M. Bentley, Washington, D. C.
276,880 Electrical Conductor. T. S. Reed, Bridgeport, Conn.
276,725 Electrical Purposes, Covering Wire for. J. J. C. Smith, College Point, N. Y.
276,724 Electrical Purposes, Machine for Covering Wire for. J. J. C. Smith, College Point, N. Y.
276,840 Heating Apparatus, Electrical. A. Lieberman, and W. Robb, Philadelphia, Pa.
276,891 Insulating Electrical Conductors. J. G. Sanderson, Scranton, Pa.
276,916 Insulating Conductors and a New Compound, suitable to be used for this and other purposes. W. Smith, Wharf Road, City Road, County of Middlesex, England.
276,889 Insulator for Telegraph Wires. J. S. Lewis, Birkenhead, County of Chester, England.
276,565 Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,566 Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,567 Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,571 Lamp, Incandescent Electric. P. Diehl, Elizabeth, N. J.
276,703 Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,704 Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,705 Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,924 Lamps, Glass Bulb or Globe for Incandescent Electric. A. Swan, Gateshead, County of Durham, England.
276,569 Railway, Electric. L. Daft, Greenville, N. J.
276,807 Railway Signal, Electric. A. W. Hall, Meriden, Conn.
276,974 Secondary Battery Plate. C. H. Koyl, Baltimore, Md.
276,604 Telephone Call, Individual. J. A. Lakin, Westfield, Mass.
276,630 Telephone, Electric. J. H. Robertson, New York, N. Y.
276,631 Telephone, Electric. J. H. Robertson, New York, N. Y.
276,783 Telephone Receiver. G. E. Shaw, Chicago, Ill.
276,632 Telephone Transmitter, Electric. J. H. Robertson, Brooklyn, N. Y.
276,702 Voltaic-arc Light. O. A. Moses, New York, N. Y.

MAY 8th.

277,286 Annunciator and Communicating Apparatus, Electric. W. Humans, Cambridgeport, Mass.
277,296 Burglar Alarm, Ringing. A. W. Lawson, Midway, Ala.
277,104 Clock Winding Device, Electric. G. F. Ballou, Waltham, Mass.
277,036 Electric Conductor or Cable, Underground. J. B. Hyde, New York, N. Y.
277,089 Electric Conductors, Manufacture of Silicious Copper and Bronze for making. L. Weiller, Angouleme, Charente, France
277,087 Electric Divining Rod. C. F. Varley, Bexley Heath, County of Kent, England.
277,237 Electric Machine, Dynamo. J. A. I. Craig, Montreal, Quebec, Canada.
277,238 Electric Machine, Dynamo. J. A. I. Craig, Montreal, Quebec, Canada.
277,119 Electric Machines, Armature for Dynamo. L. Daft, Greenville, N. J.
277,374 Electrical Conductor. S. D. Strohm, Philadelphia, Pa.
277,020 Fire Alarm Box, Electric. B. Frese, Chicago, Ill.
277,053 Gas by Electricity, Device for Lighting. J. B. Odell, Chicago, Ill.
277,248 Insulated Conductor of Electricity, Electro plated. N. H. Edgerton, Philadelphia, Pa.
277,366 Insulated Electrical Conductor. W. Smith, Wharf Road, City Road, County of Middlesex, England.
277,166 Lamp, Electric-arc. A. Shedlock, Brooklyn, N. Y.
277,167 Lamp, Electric-arc. A. Shedlock, Brooklyn, N. Y.
277,168 Lamp Holder, Electric. A. Shedlock, Brooklyn, N. Y.
277,377 Lamp Hood, Electric. S. H. Tacy, New York, N. Y.
277,069 Magneto-electric Machine. C. A. Seeley, New York, N. Y.
277,390 Railway Signals, Circuit Instrument for Electric. J. Weis, Jersey City, N. J.
277,358 Railway Trains, Electric Signaling Apparatus for. F. A. Shaw and H. E. Judkins, Portland, Me.
277,179 Speed Indicator, Magnetic. E. Weston, Newark, N. J.
277,349 Telegraph, Automatic. J. H. Rogers, Washington, D. C.
277,335 Telegraph Cable, Splice. W. R. Patterson, Chicago, Ill.
277,007 Telegraph Line, Underground. W. Cohlman, Philadelphia, Pa.
277,112 Telephone. H. Clay, Philadelphia, Pa.
277,199 Telephone, Receiving. M. L. Baxter, Aurora, Ill.
277,198 Telephone, Receiving. M. L. Baxter, Aurora, Ill.
277,145 Telephonic and other Electrical Purposes, Line Changer for. C. H. Lothrop, Lyons, Iowa.
277,241 Thermostat. W. G. Day, Baltimore, Md.

MAY 15th.

277,738 Burglar Alarm, Ringing. T. E. James, Rochester, N. Y.
277,640 Circuit Controller Device. E. Weston, Newark, N. J.
277,523 Electric Cable Support. A. Wright, Providence, R. I.
277,628 Electric Lock. M. Sullivan, Brooklyn, N. Y.
277,644 Electric Machine, Dynamo. E. Weston, Newark, N. J.
277,588 Electric Wires, Laying Underground. J. Marks, Newark, N. J.
277,475 Electro-magnetic Engine. G. W. Foster, New York, N. Y.
277,610 Gas Lighting, Electric. T. H. Rhodes, Brooklyn, N. Y.
277,536 Head Light for Locomotives, etc., Electric. F. Ball, Jr., Cincinnati, Ohio.
277,519 Insulating Wire for Electric Purposes. J. J. C. Smith, College Point, N. Y.
277,646 Lamp and Holder, Electric. E. Weston, Newark, N. J.
277,645 Lamp and Holder therefor, Electric. E. Weston, Newark, N. J.
277,641 Lamp Bracket, Electric Incandescent. E. Weston, Newark, N. J.
277,642 Lamp Bracket, Electric Incandescent. E. Weston, Newark, N. J.
277,846 Lamp Carbons, Manufacturing Incandescent. H. S. Maxim, Paris, France.
277,643 Lamp Fixture, Electric. E. Weston, Newark, N. J.
277,781 Measuring and Recording Electric Currents, Apparatus for. J. Hopkinson, Westminister Chambers, County of Middlesex, England.
277,569 Railway Signal, Telegraphic. R. M. Hunter, Philadelphia, Pa.
277,445 Secondary Battery. E. Boettcher, Leipsic, Germany.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Bradford, C., Solicitor of American and Foreign Patents, 16 & 18 Hubbard Block, corner Washington and Meridian Streets, Indianapolis, Ind.

Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C., Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 43 Centre Street, New York.

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Electrical Energy Accumulators,

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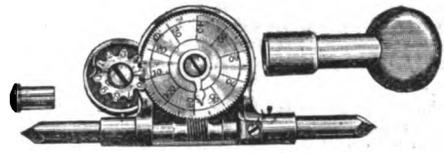
CHURCH'S PATENT IMPROVED
DOUBLE SPEED INDICATOR
Either Right or Left.



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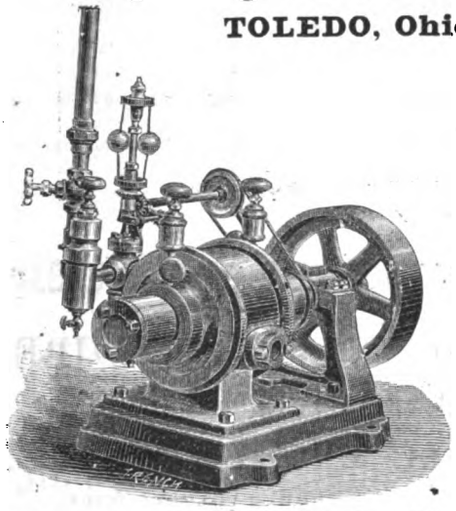

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Noiseless, light running, high speed, uniform motion.
Two to twenty horse-power.
Especially adapted to private plants, where space is limited.

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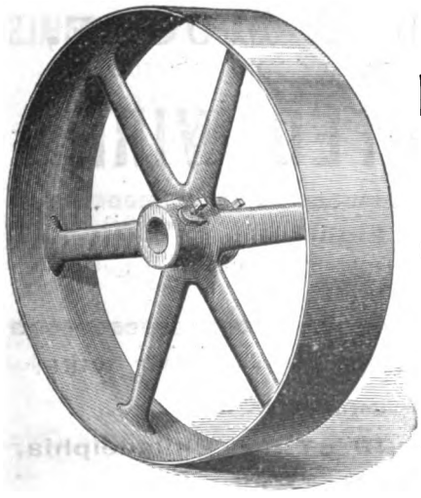

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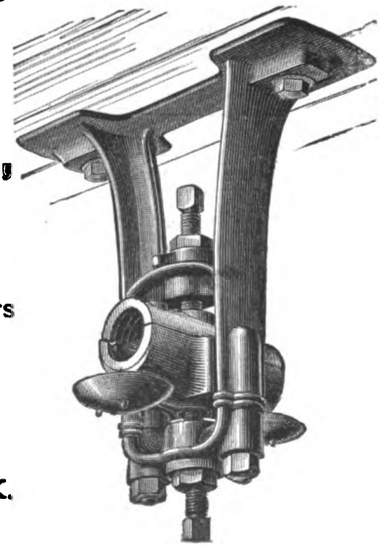

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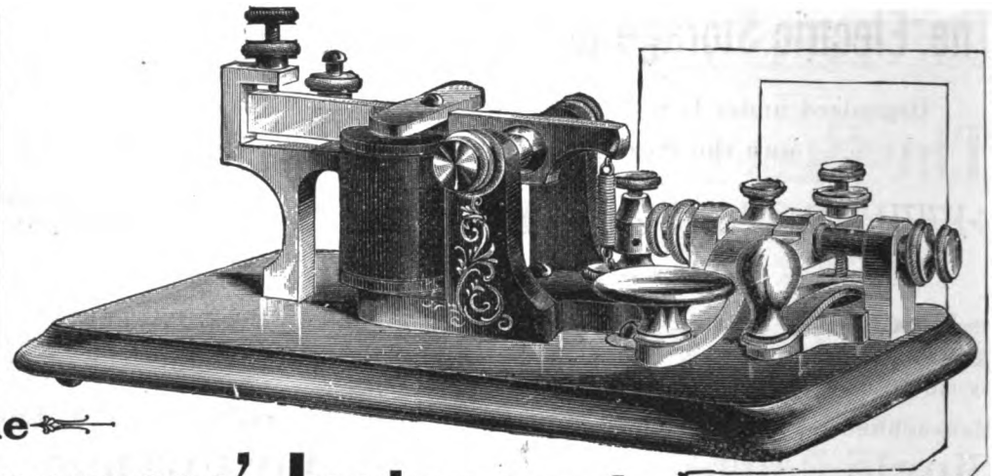
Price $3.75, complete with Battery, Book of Instruction, Wire, Chemicals, and all necessary materials for operating.

"Morse" Instrument alone, without battery,	$3.00
"Morse Instrument without battery, and wound with fine wire for lines of one to fifteen miles,	3.75
Cell of battery complete,	.65
"Morse" Learners' Instrument, without battery, sent by mail,	3.50

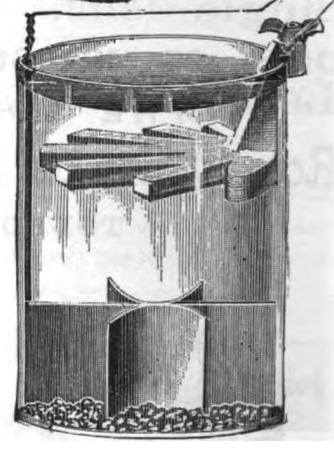
(Battery cannot be sent by mail.)



The

"Morse" Learners' Instrument

THE BEST



The "Morse" is a full size, well made, complete MORSE TELEGRAPH APPARATUS, of the latest and best form for learners, including handsome Giant Sounder and Curved Key, and a large Cell of the best Gravity Battery, latest form.

It is the best working set of Learners' Instruments for short or long lines, from a few feet up to twenty miles in length, yet offered.

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SHEET BRASS, COPPER, AND GERMAN SILVER.

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Zinc Rods for Battery Purposes

PURE COPPER WIRE made from BEST LAKE SUPERIOR COPPER, Conductivity Guaranteed.

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"ELGIN"

TELEPHONE,

FOR PRIVATE LINES.

Made Wholly of Metal.

Nickel Plated and Highly Polished.

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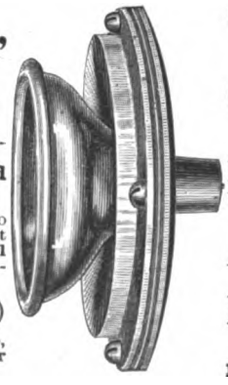
Including 200 feet Wire, with full instructions for putting up.



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Having the right to use the

TUBULAR + STEM on Rear Plate,

Making it **Self-Supporting**, requiring no screw or bracket to hold it in place.

Beware of Imitations!

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SUPPLANTING ALL OTHERS.

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Single Cells, - - Only $1.25.

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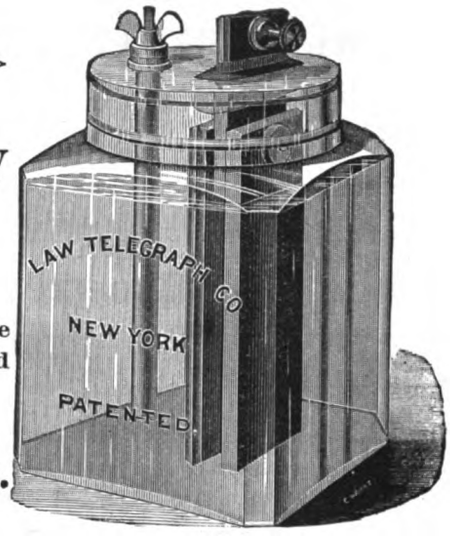
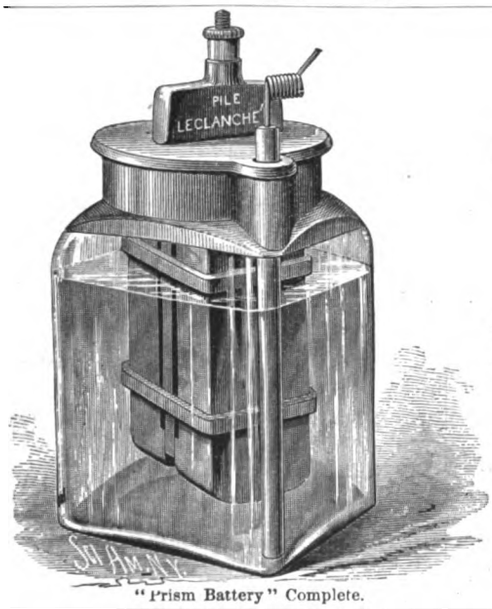


Law Telegraph Co., 140 Fulton St., New York.



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LECLANCHÉ BATTERY.

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GREAT TELEPHONE BATTERY,

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In Electric Open Circuit Batteries.

Free from acid. Emits no odor. Does not get out of order. Lasts without renewal from six months to several years, according to use.

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all the Telephone Companies and Exchanges in the United States.

The Prism Battery is more easily and cheaply cleaned and renewed than any other battery. Beware of

INFRINGEMENTS AND WORTHLESS IMITATIONS.

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"Prism" and Porous Cell Batteries for sale in any quantity. Zinc and Sal Ammoniac of superior quality

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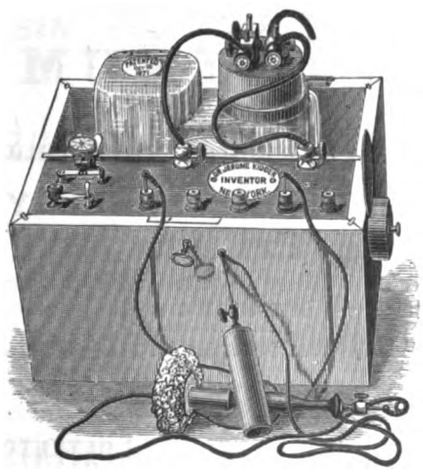

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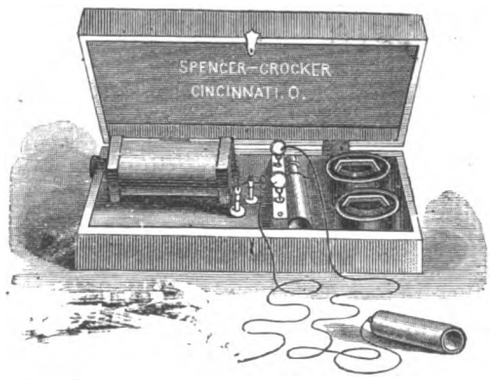

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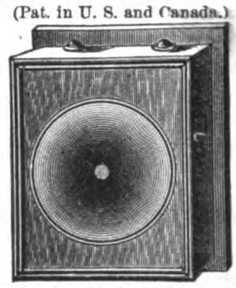

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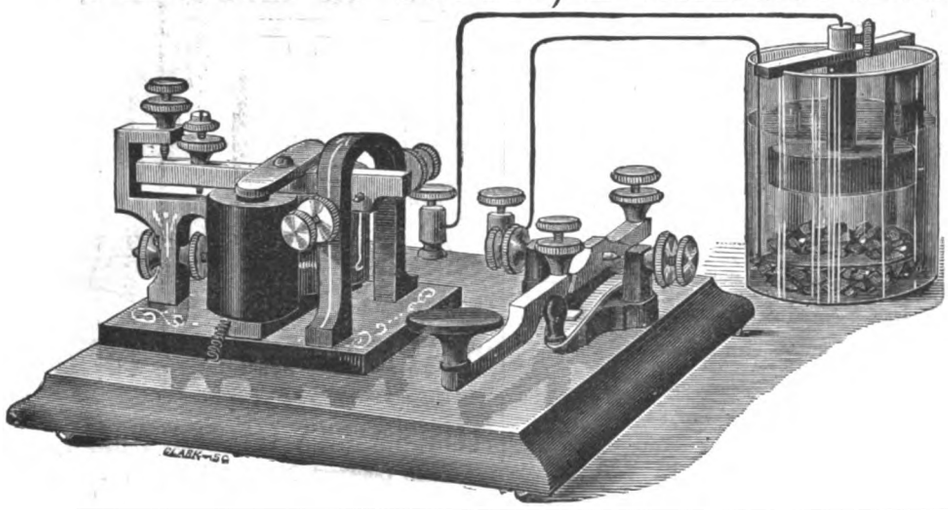

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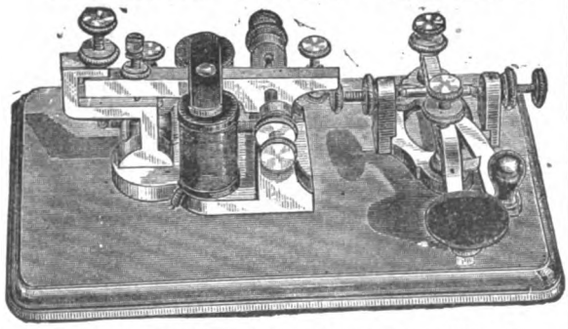

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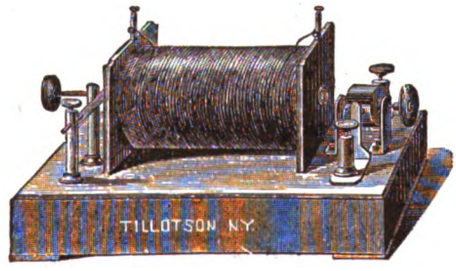

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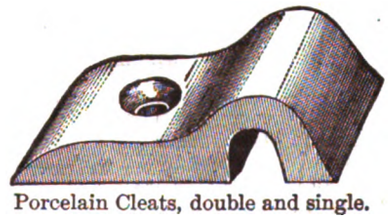

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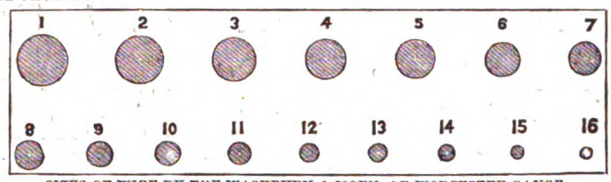

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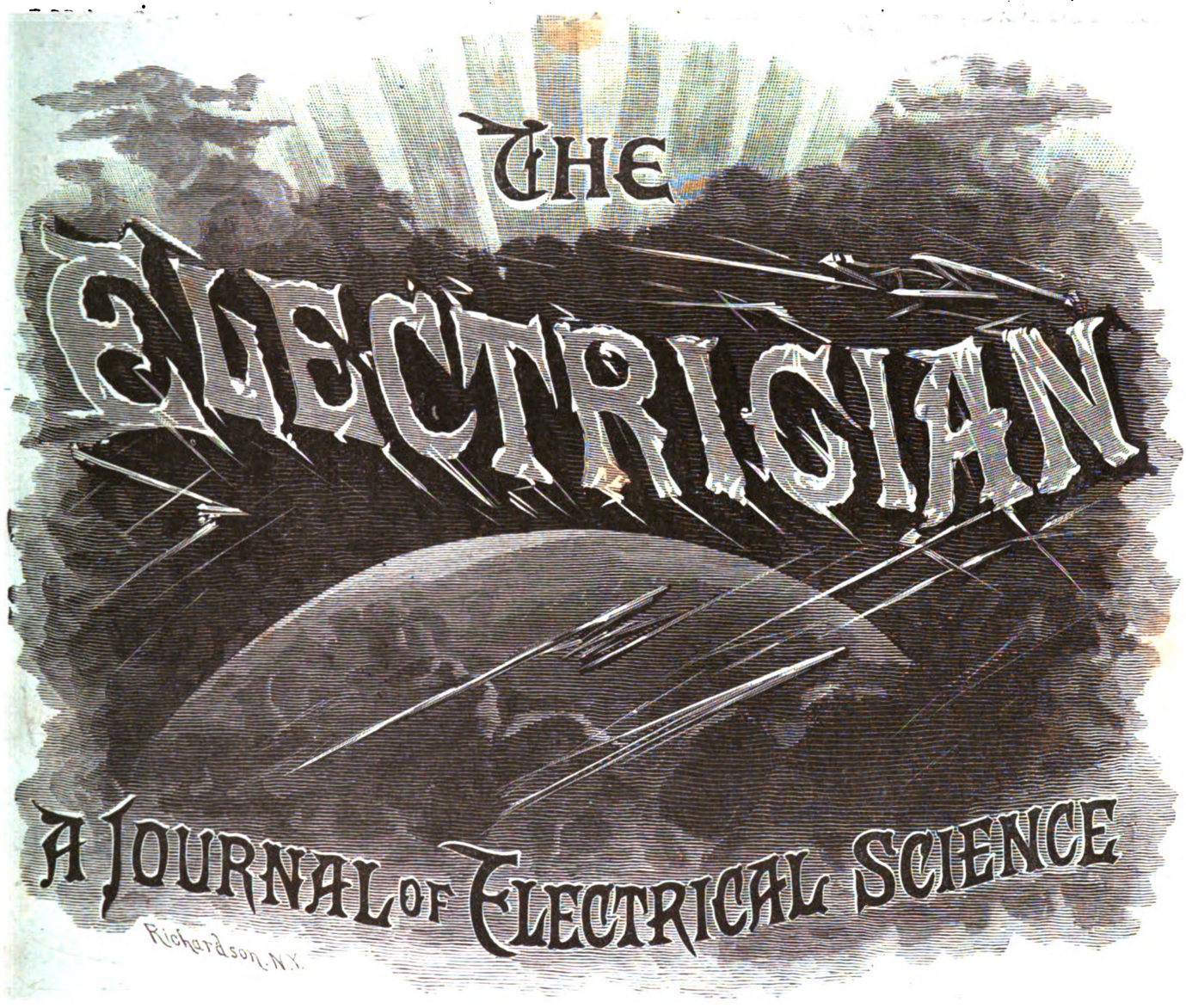

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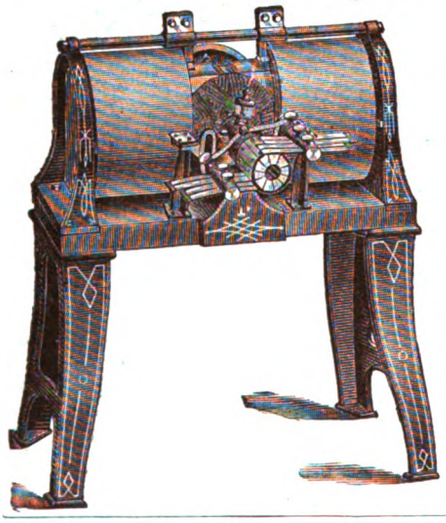

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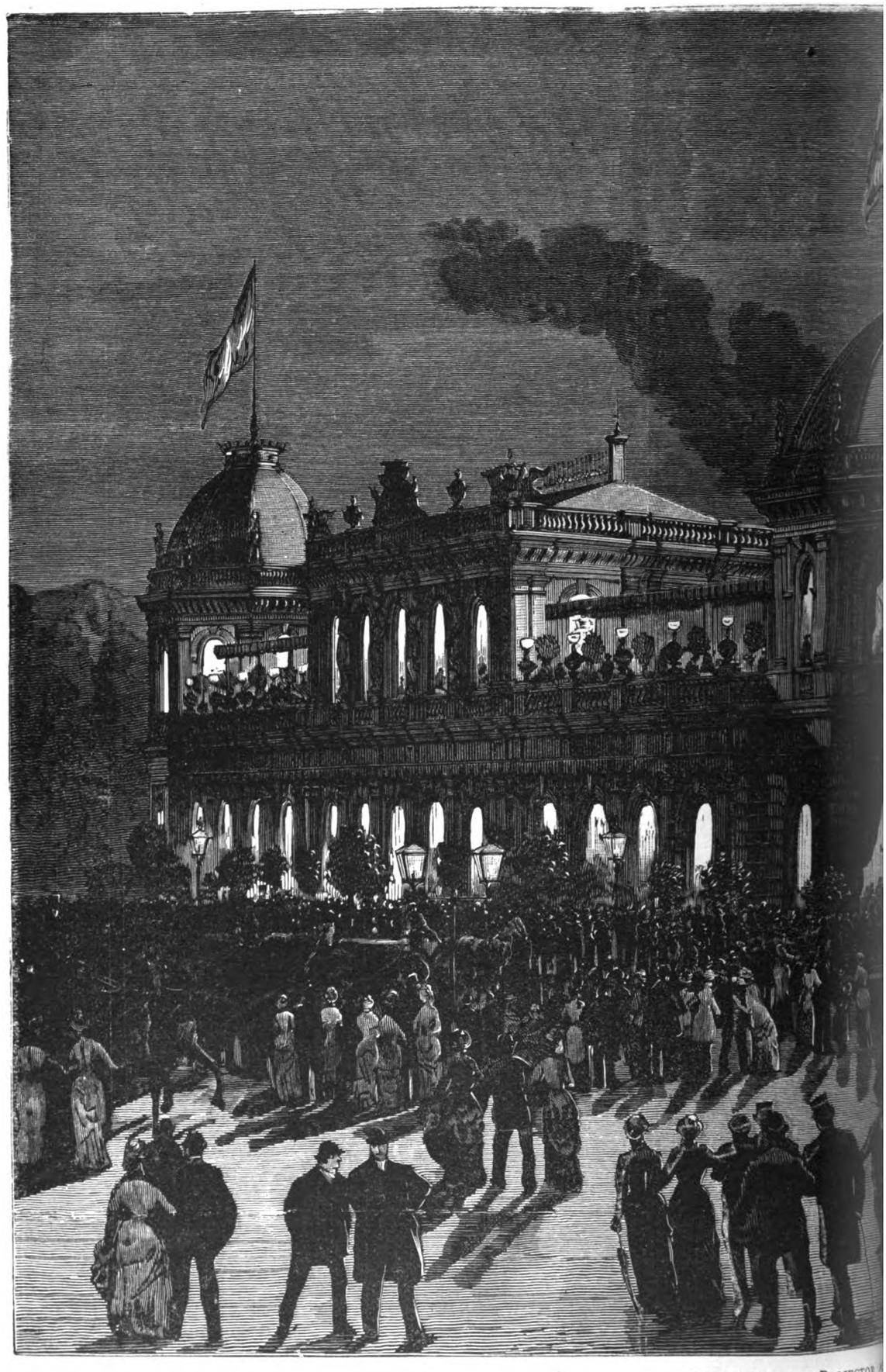

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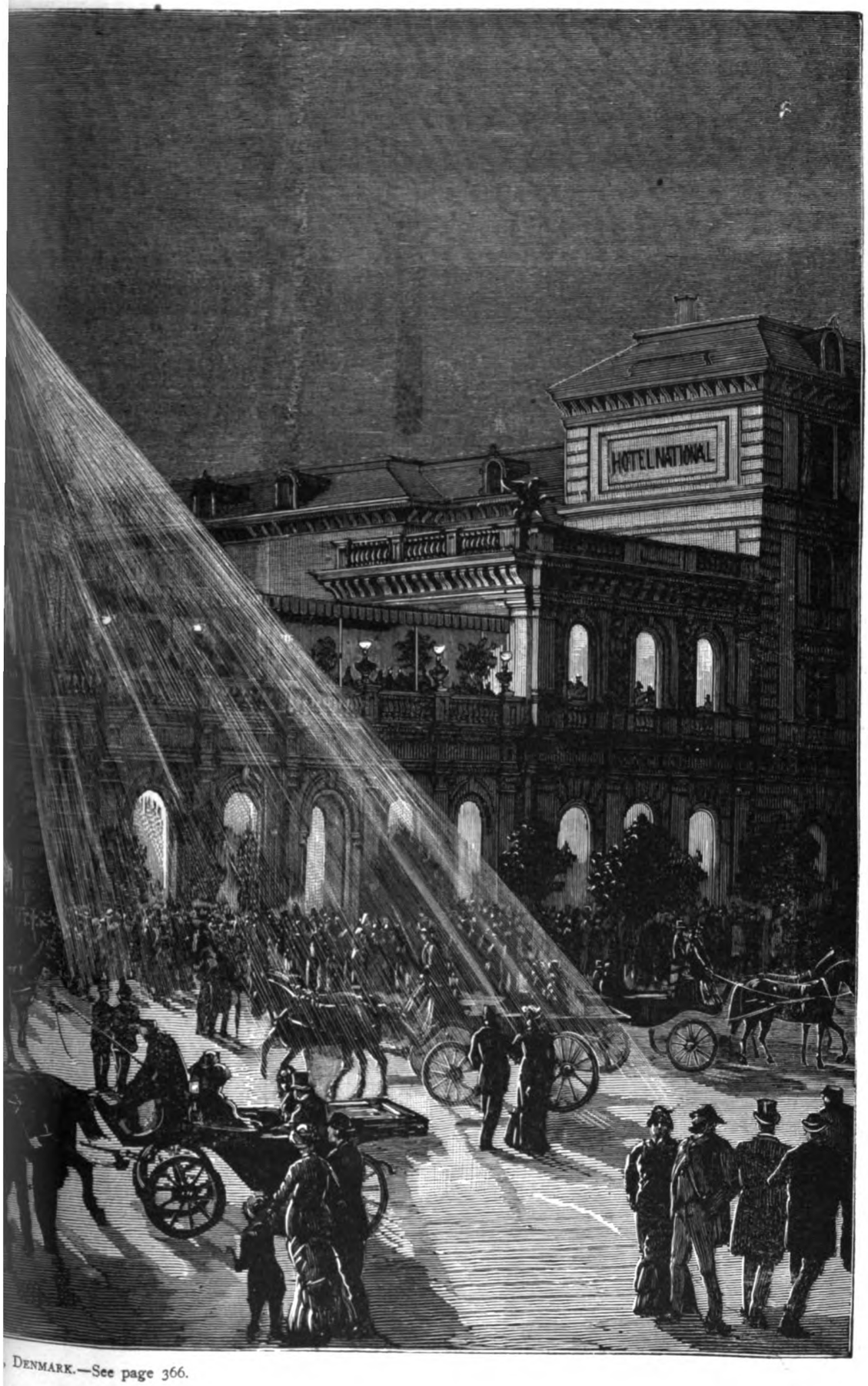

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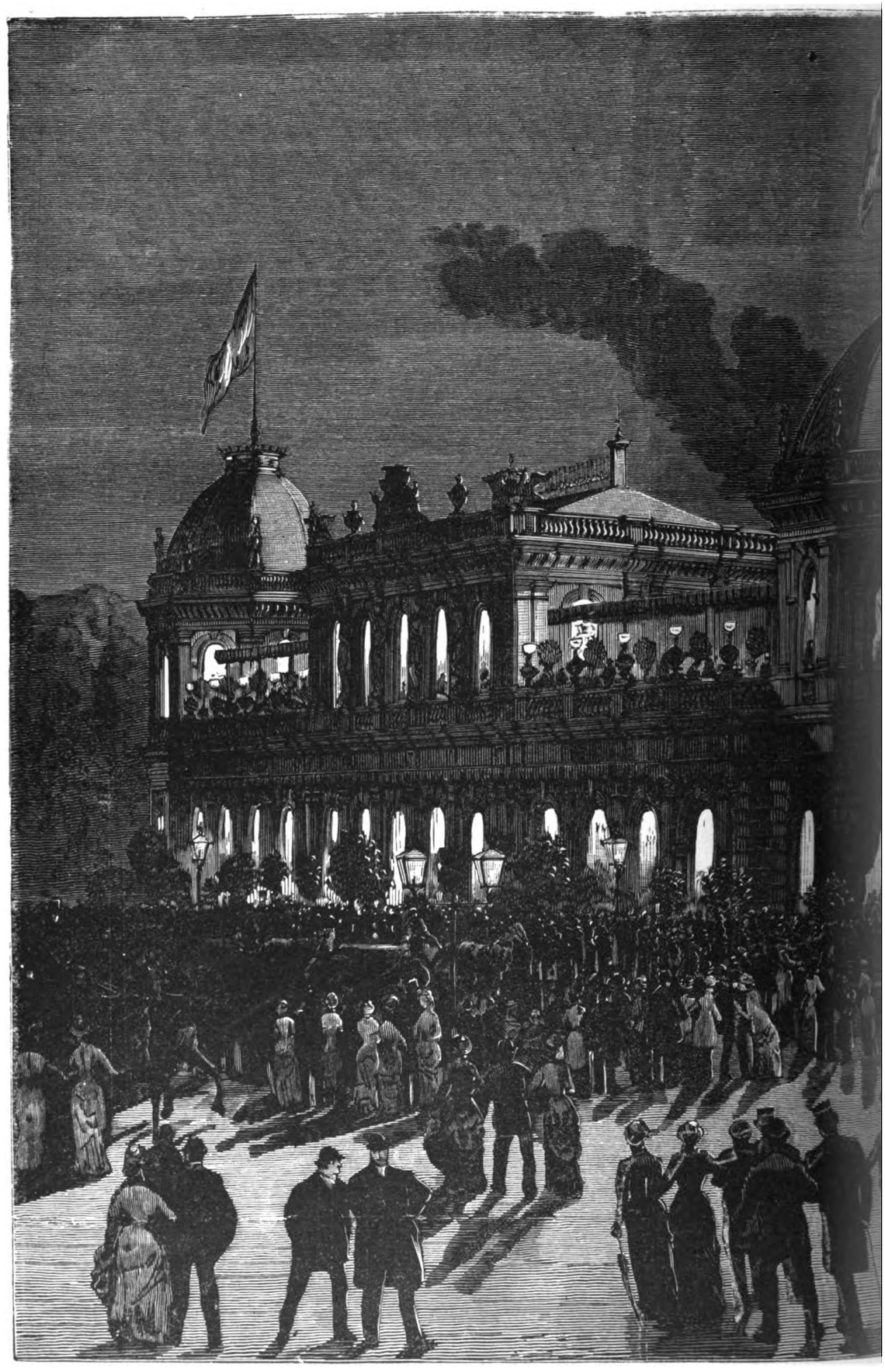

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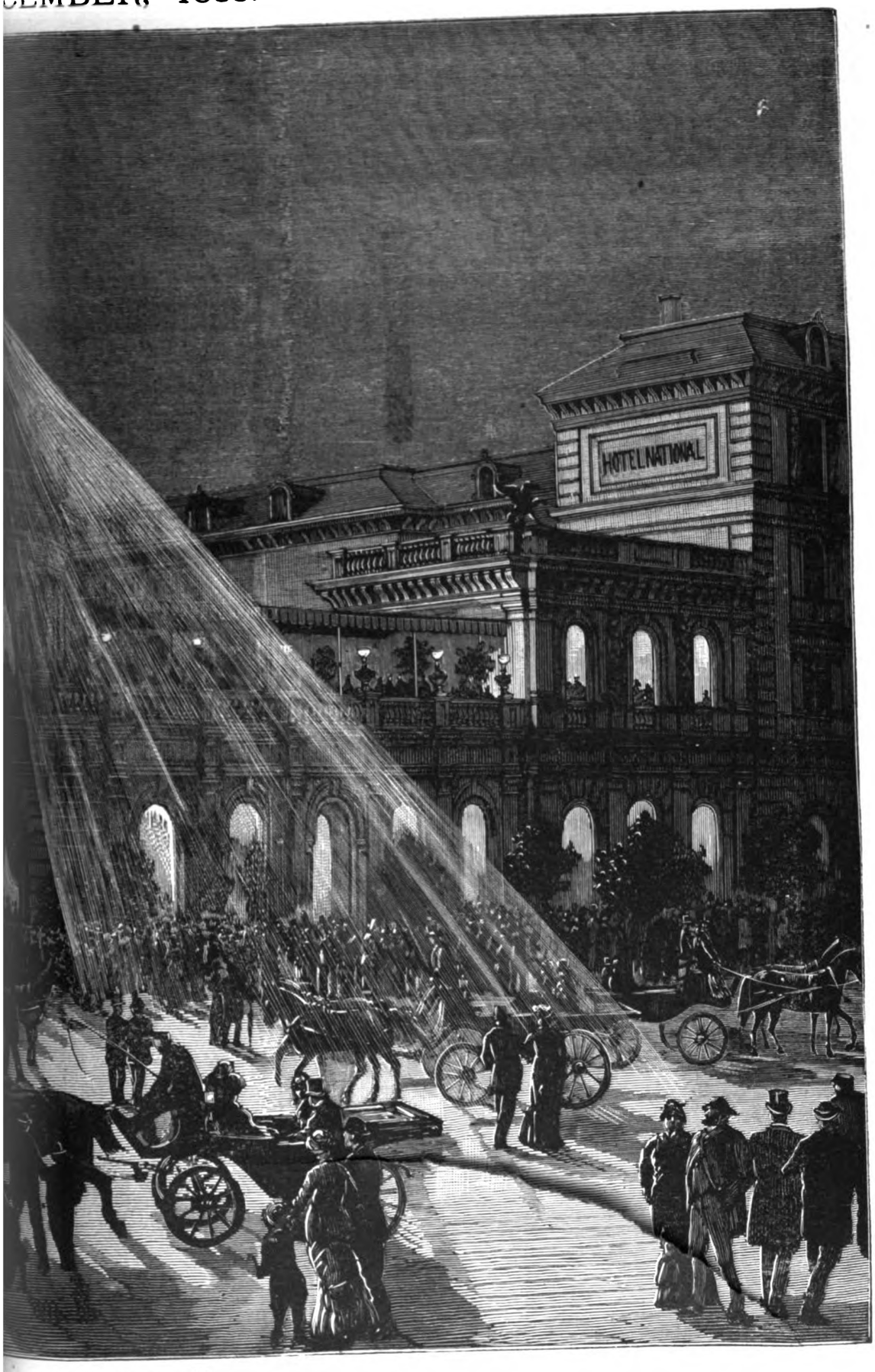

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THE ELECTRICIAN.

Vol. II. No. 12.] DECEMBER, 1883. [$1.00 a Year. 10 Cents a Copy.

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A NEW DYNAMO FOR EXPERIMENTING PURPOSES.

SINCE the introduction of electricity for illuminating, plating, and for the general uses to which it is now put, there has sprung up a considerable demand for a powerful and economical working dynamo for general experimenting.

A great many experiments, in which parties may be interested, and without doubt would perform if they had a powerful and economical source of electricity at hand, are not undertaken on account of the time, expense and trouble required to properly arrange a galvanic battery for working order. In this way they lose an opportunity of attaining the practical knowledge and enlarged experience to which such experimenting leads.

We illustrate a machine, made by I. W. Colburn & Co., of Fitchburg, Mass., which seems to fill a long desired want. The object was to produce a machine capable of developing a current of sufficient quantity and intensity to meet the demands of any laboratory, and one absolutely free from the defects common in other machines of this class.

These machines, we are informed, are more successful in their action, than the parties at first dared to hope for. With these machines the current can be perfectly regulated.

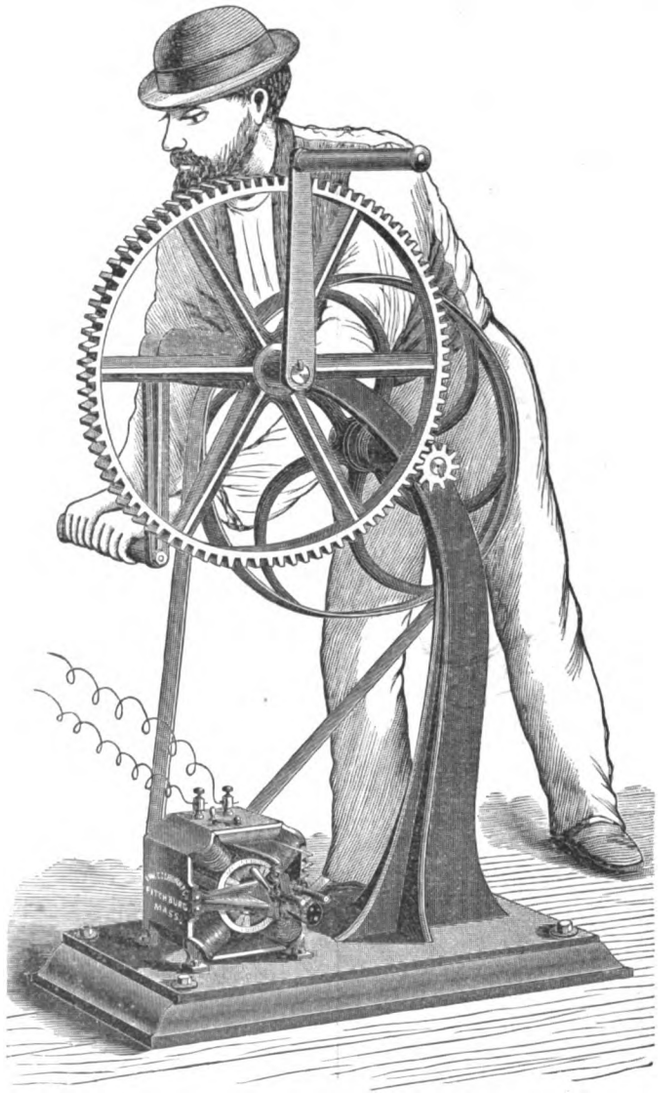
They furnish a current of sufficient power to operate three incandescent lamps, or one small arc light sufficiently strong for illustrative purposes. The machine requires about two man-power to operate it at its fullest capacity; but one man can develop sufficient electrical energy for general experimenting—the current developed being according to the power expended in operating machine.

When convenient, machine may be operated by steam, water, or any other power at command; and in such case it may be run continuously, if desired.

This machine, besides being very useful for general experimenting, is used to a considerable extent for practical purposes. A large number have been constructed for cautery use, and in every case are said to have given the best satisfaction.

With the use of this machine for cautery, a great deal of annoyance is avoided by the surgeon having the operation in charge. Will heat, white hot, a long piece of No. 16 platinum wire.

The machine is made very rigid, and runs perfectly even and free from noise, the gears being cut.



As will be seen, the machine rests upon a heavy and strong iron base, with an upright column all cast in one piece. The weight of base and column is 375 pounds. There are bolt holes in base for securing machine to floor. The machine is so speeded up, that with a slight exertion on part of person operating crank a very fast speed can be attained for the armature.

The machine can be run up to a speed of 1,800 revolutions per minute, and kept there without showing any heat in the armature or field coils.

The frame of machine is cast in one piece, and thus gives it absolute rigidness; besides the pole pieces of the exciting field are all secured to a solid composition ring, one on each side of poles. Machine is thus enabled to run perfectly free from vibration.

The armature is of the improved Gramme type. Current passes from armature coil through insulated wire in centre of shaft to the commutator, which is outside the bearings. This gives easy access to brushes, and they can be readily adjusted.

Unlike other machines, the commutator brushes, instead of being horizontally parallel, are set at an angle of 90° from each other.

The machine, when constructed for experimental purposes, is wound with quite small wire, and furnishes a current of 60 volts and 3½ ampéres; when constructed for cautery use, it is wound with large wire, and then develops 4 volts and 50 ampéres.

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These machines are claimed to be useful for professors in schools and colleges, in illustrating the science of electricity; also to enable them to facilitate their researches in this line. With these machines all the experiments possible with a battery, and many for which a battery is unfit, may be successfully performed.

Very little space is occupied, and after first cost there is nothing to be figured as operating expenses, unless it is the interest on money invested in machines, and that is so slight, as not to be worth the reckoning. The first cost of the machine is a trifle more than that of a chemical battery of same power; but the cost of a battery after one month's use, would far exceed that of the dynamo; and the battery would be much out of repair, while the dynamo would be in perfect order.

SOME OF THE DEVICES OF M. G. TROUVÉ.

WHILE the establishment of systems of electric lighting from central stations has chiefly occupied the attention of electricians, some attempts have been made to devise appliances for the production and use of electricity for illuminating purposes in private residences, which have led to no extraordinary advance, but have certainly developed suggestions, which will eventually be more or less available.

M. G. Trouvé, of Paris, France, an ingenious inventor, has, among other matters, considered this problem, and the system of domestic lighting proposed by him requires the following devices, which are now in the market abroad.

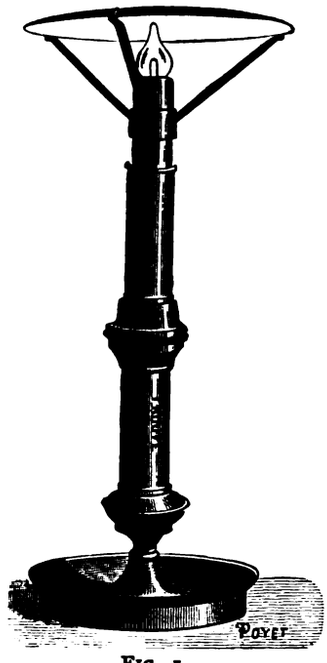

FIG. 1.

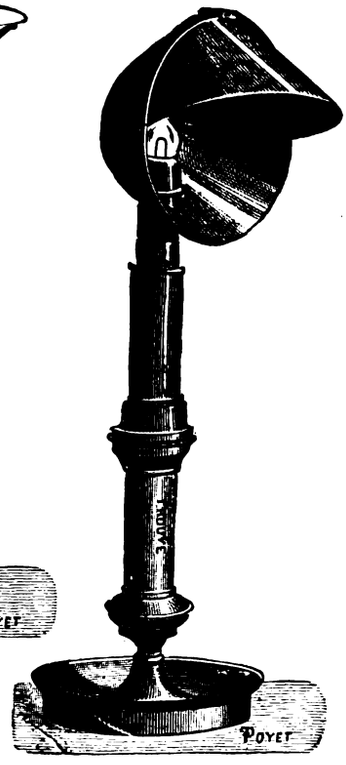

FIG. 2.

For a table or reading lamp, he proposes the form Fig. 1, which consists of a small incandescence lamp, supported on a plain column, about the size of an ordinary candle, and surmounted by a reflector which throws its entire light downwards upon the table; or the lamp may be enclosed in a hood, which cuts off its rays from all but one

FIG. 3.

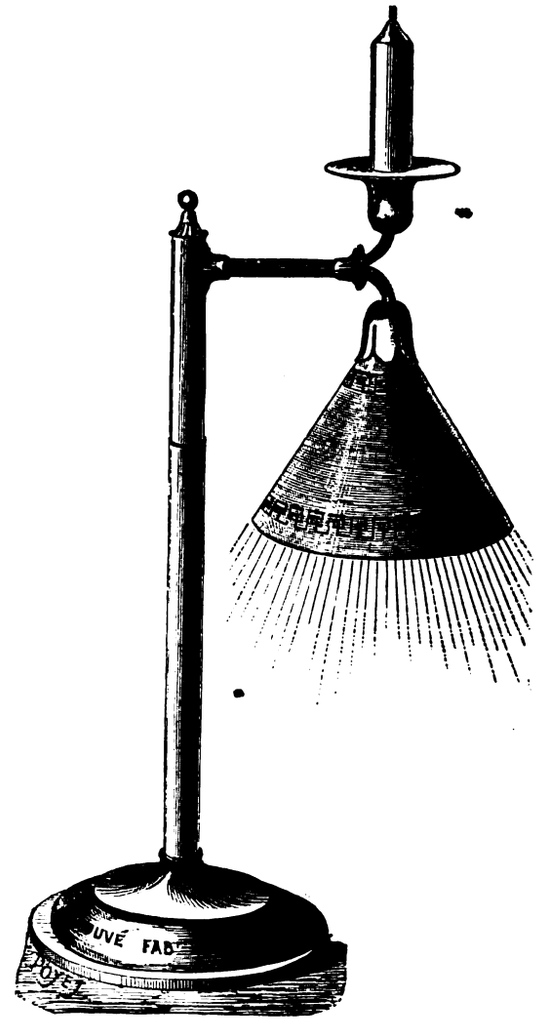

FIG. 4.

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direction, as in the reading lamp, Fig. 2. A small lamp, throwing a very intense light in one direction only, may be formed by mounting the photophore[1] of M. Trouvé, as in Fig. 3; a more ornamental table lamp is shown in Fig. 4, which exhibits the combination of an ordinary candlestick and an incandescence lamp with an artistic design which adapts them for parlor use. These lamps are all of 12

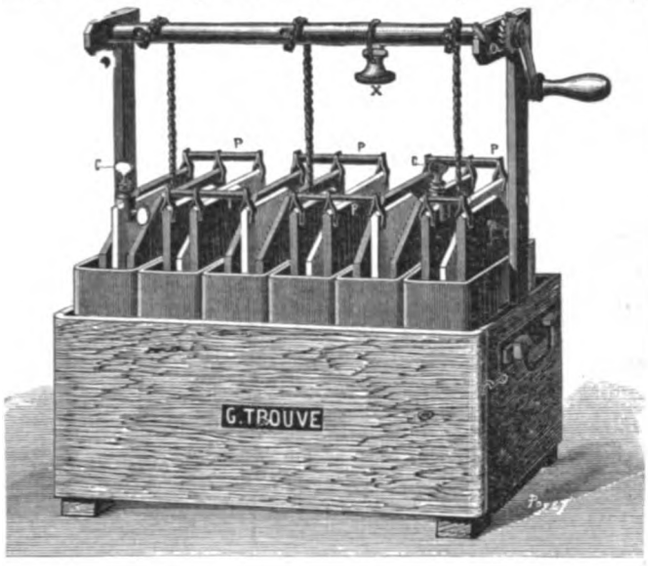

FIG. 5.

candle power, and the pedestal is attached by an almost invisible, flexible wire cord, with the electric source. The candles supported by the latter forms, produce, when lighted simultaneously with the electric lights, a very agreeable mixed light, and when the lighting cable is detached, permit the use of the lamp as an ordinary chandelier.

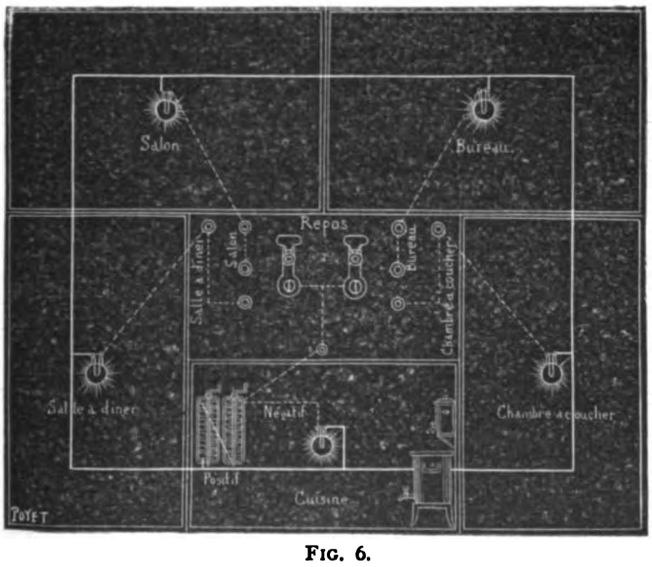

FIG. 6.

To supply electricity for these lamps an ordinary carbon and zinc plunge battery, Fig. 7, modified to suit its special application, and actuated by a solution of bi-chromate of potash in sulphuric acid, is employed. This may be situated in the kitchen, as represented in the plan Fig. 8, which has been successfully in operation for several months in a private house in Paris. From one of its poles is led a lighting cable as shown by the white line, which in the Fig. leads from and returns to the positive pole.

1. Described in the ELECTRICIAN, vol. 2, June, 1883.

The negative conductor is represented by a dotted line which leads first to a lamp in the kitchen that is connected by an ordinary commutator. A special resistance coil associated with this lamp, permits it to be lighted without injury, even though all the others be abruptly extinguished. A branch of the negative conductor leads to a pair of handles which are situated in the middle of the commutator used to distribute the current to several apartments.

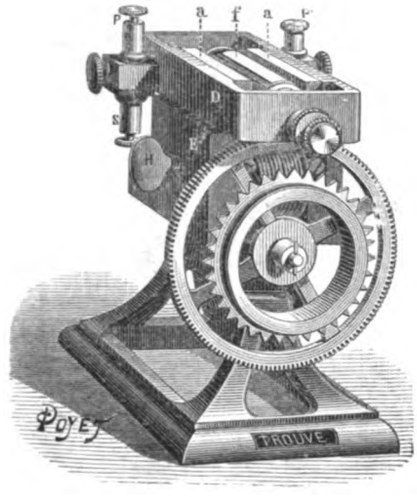

FIG. 7.

Various press buttons, each associated with its special lamp, may be thrown into circuit by this commutator, each separately or all together, as may be desired; and conveniently disposed reservoirs of stoneware, enable even an ordinary domestic to prepare the solutions and charge the battery without difficulty.

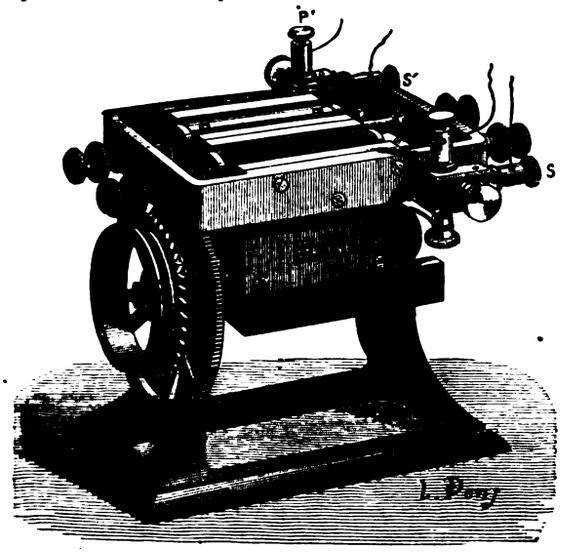

FIG. 8.

The battery above described is also adapted for use in connection with the system of electric navigation, devised by M. Trouvé. The motor employed in this system is shown in Fig. 7, and a modification, having double the power, in Fig. 8, and the remarkable feature of the system is that the motor is fixed upon the rudder of the vessel and drives a propeller, which also forms part of the rudder, as may be seen in Fig. 9. The batteries are located amidship, and may be two in number, driving a 2 bobbin motor, as in Fig. 10; 4 in number, driving a 4 bobbin motor as in Fig. 11.

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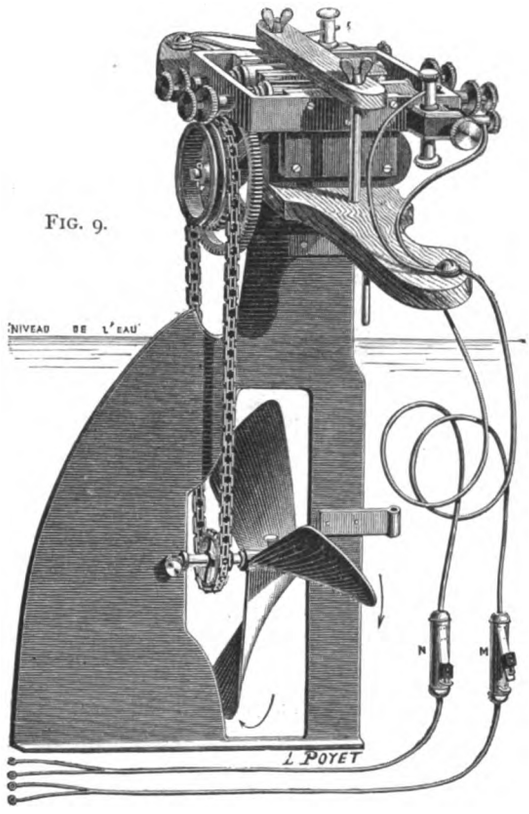

FIG. 9.

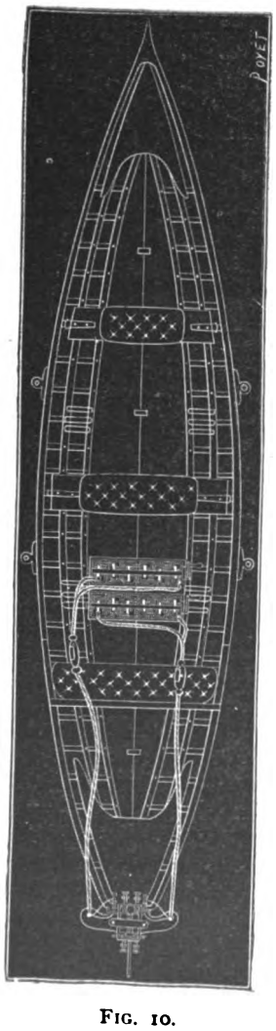

FIG. 10.

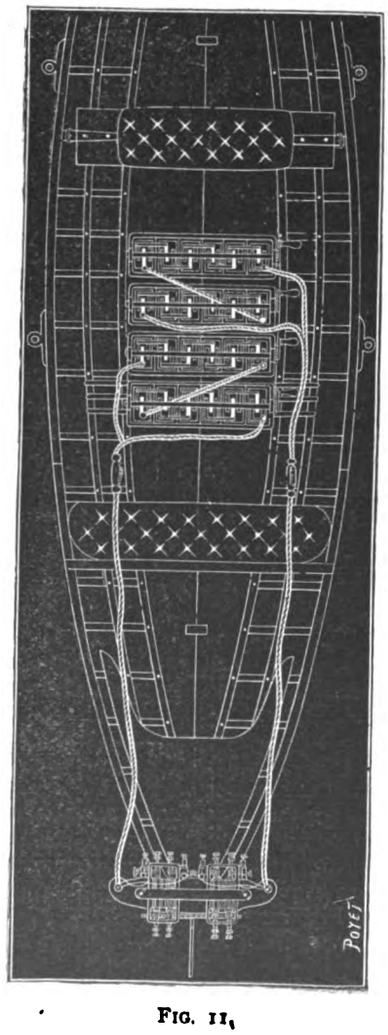

FIG. 11.

In either case the current is conducted to the motor by cables, which form part of the rudder cords, and the handles thereon, held by the pilot or cockswain contain commutators, by means of which the operation of the motor may be interrupted or reversed at pleasure. Hence, the system affords remarkable control over the movements of the boat. In fact, it may be turned about almost as if on a pivot.

ELECTRIC LIGHT PROJECTOR AT COPENHAGEN.

THE striking cut on our first page, for which we are indebted to *The Illustrevet Tidende*, of Copenhagen, represents a view of the "Cafe National" at Copenhagen, Denmark, lit up by the Maxim and Weston system. The plant consists of one Weston No. 5 10 arc light machine, one Weston 100 incandescent light machine, and one small Maxim machine for the projector. Besides the projector on the roof, there were 10 Weston arc lights, and 120 incandescent Maxim lights.

THE DYNAMO: HOW MADE AND HOW USED.

(*Continued from page 332.*)

§ 4. The student will do well to compare the effects produced on the galvanometer by the battery current, and by the current obtained from the magnet. Any single cell will do for this purpose; and in order to have an intelligent perception of what takes place, the student must bear in mind, that *in* the battery itself, the electricity (undulatory movement of the molecules) passes from the zinc to the negative plate (be it copper, silver, platinum, or graphite), while *outside* the battery, the electricity passes from this latter round through the wires, galvanometer, or other circuit open to its passage, back again to the zinc plate (see Fig. 4, where the direction of the undulation, or "current," is shown by the arrows; the plate marked *Z* being zinc, the one marked *C* being carbon, copper, or other conductor; *W W* being the wires forming the *poles* or *electrodes*). If the positive pole (the one from which the "current" is flowing, the wire attached to the *C* plate) of such a battery be connected to the galvanometer by means of the binding screw marked "over," the other pole being attached to the other binding screw, the North pole of the needle having previously been adjusted so as to lie between the two binding screws, it will be found that the N. pole of the needle will deflect to the *left* of the line of the coil; the operator being supposed to be standing at the binding-screw end of the galvanometer. Since the wire of our coil returns *below* the needle, it is evident that a positive current (an outflow of undulation) passing *over* the North pole of a horizontally suspended needle, or a negative current (an influx of undulation) passing *under* such a North pole, causes it to deflect to the *left*.

If we disconnect the battery, and reverse the connections, *id est*, join the negative pole (the wire coming from the zinc) to the binding screw marked "over," the other pole being connected to the other screw, the opposite effect results—viz., the North pole now deflects to the *right* of the coil. This will be understood by reference to Fig. 5, in which *a* represents the effect of the positive current flowing *from* the operator *over* the needle, the N. pole in both illustrations being nearest to him; in *b* the positive current is supposed to be flowing *from* the operator, *below* the needle, in either case returning to the battery the opposite way.

§ 5. This effect will enable us at once to recognize, by means of our galvanometer, the *direction* in which a current is traveling; for, on connecting the two terminals of any source of electricity to the binding

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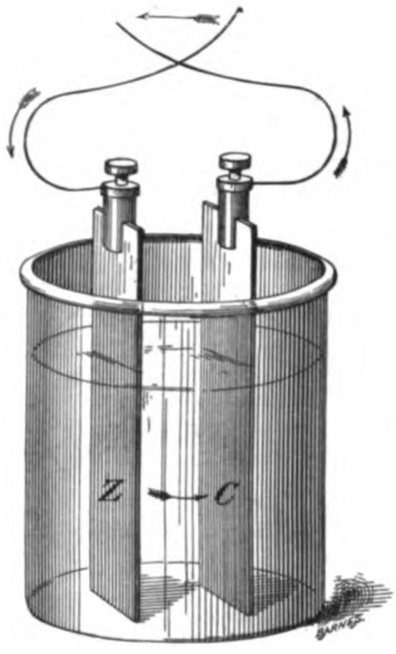
screws of the galvanometer, whilst the N. pole is in a line with the coils, between the two binding screws, the operator facing the North pole of the needle, it is evident that if the N. pole of the needle is deflected to the *left*, the terminal attached to the binding screw marked "over" is *positive*; but that, if the N. pole deflects to the *right*, then the said terminal is *negative*. It must be borne in mind, that by the term *positive*, in this connection, is meant the point *from* which electricity is flowing, negative being the point *towards* which it is flowing, or *at* which it enters * This power of recognizing the direction of a current, will be found of great service to us in the construction of the dynamo.

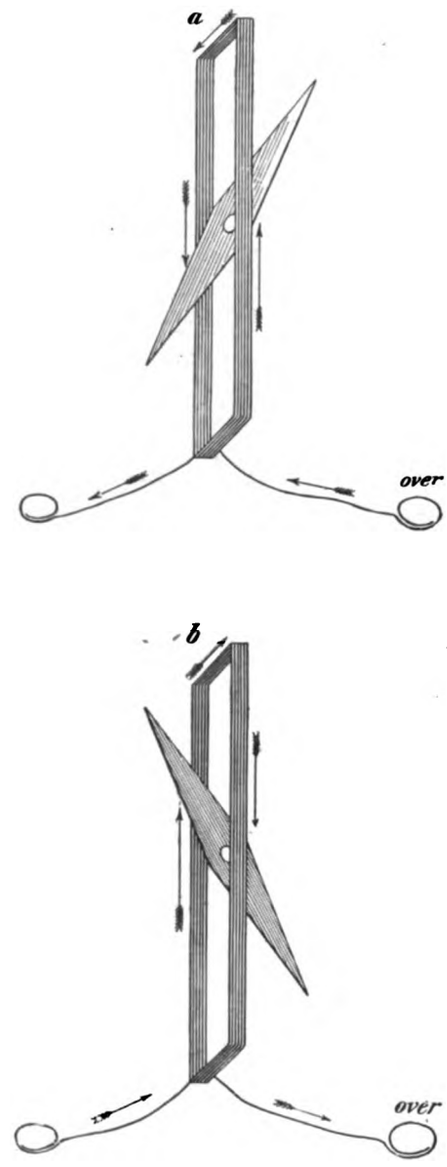
Fig.4.



§ 6. Returning, now, to our experiments with the magnet (see latter portion of § 3), and using, in preference, a straight soft iron rod, about 6 in. in length, and ½ in. in diameter, coiled with about 100 ft. of No. 24 covered wire, as our armature, and a good bar magnet to produce the electrical effects, we shall find, on coupling up the armature wires to the galvanometer, and approaching one end of the armature to or receding it from the N. pole of the magnet, that the electrical flow set up is always in one direction in approaching or making contact, and in the opposite direction on receding or breaking contact. Fig. 6 will make this clear. The arrow at *a* shows the direction of the current produced on approaching or making contact with the N. pole of a magnet; *b* illustrates the direction of current produced on receding from or breaking contact with the N. pole of a magnet. If now we reverse the experiment, by presenting the S. pole of the magnet to the coiled armature, we shall find that the direction of flow is also reversed; that is to say, the *withdrawal* of a South pole produces the same effect as the *approach* of a North pole, and *vice versa*, the *approach* of a South pole is equivalent in its effects to the *recession* of a North pole. It must be noted, that the direction in which the wire is coiled round the soft iron rod (or armature), while it has no influence on the direction of the electrical current set up round the iron rod (which is always the *reverse* to the hands of a clock in the face *approaching* the North pole) determines the extremity of the said wire at which the current leaves or enters the coil. In the Fig., we have supposed the wire to be wound from *left* OVER towards *right*; had we wound our rod from *left* UNDER towards *right*, the opposite ends of the wire would have been, respectively, + and —. This must be borne in mind when we proceed to actual work.

* We have no desire to enter into any theoretical matters in these papers; but comparing electricity to sound, we may say, that in blowing a blast in a trumpet, the trumpet may be considered as *positive*, while the ear of the listener may be considered as being negative. The chief difference seems to be, that electrical undulations seem to require a complete circuit wherein to display their effects—sound undulations being bound by no such conditions.

Fig.5.



§ 7. *Currents can produce Magnetism.*—If we take the coiled soft-iron *U*, of which we made use, § 3, and apply it to pieces of soft iron, nails, filings, etc, we shall find that it possesses little or no magnetic power of attraction; but if we couple the projecting ends of the coiled wires, one to each terminal of a single cell battery, we shall find that the *U* will become powerfully magnetic, retaining its magnetism as long as electricity flows around the coils, but losing nearly all the instant that the flow is caused to cease, either by breaking connection with the battery, or by any other interruption. The rapidity and completeness with which the iron loses its magnetism, depends almost entirely on its *softness* and *purity*. Anything which tends to put a strain on the molecules of the iron—such as hammering, filing, twisting, sudden cooling, vibration, etc., —render it liable to retain magnetism, or increase its *coercitive* force; whereas, raising to a high temperature and very gradual cooling, which allows the molecules to range themselves with little or no strain, furnishes a soft iron, eminently incapable of retaining magnetism, or possessing little *coercitive* force.

§ 8. The direction in which the flow of electricity takes place aroun d the iron bar decides which end of the bar acquires *North seeking*, and which *South seeking* polarity. Let us suppose, as in Fig. 7, *A*, that one extremity of the bar be made to face us, and that the current be caused

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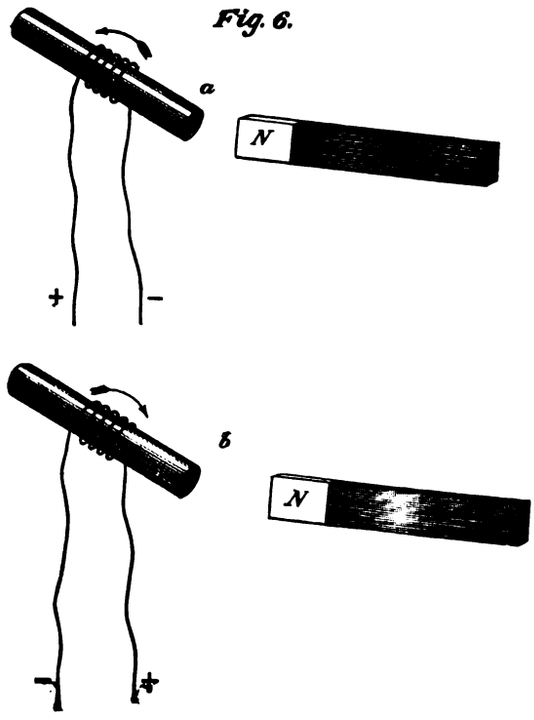
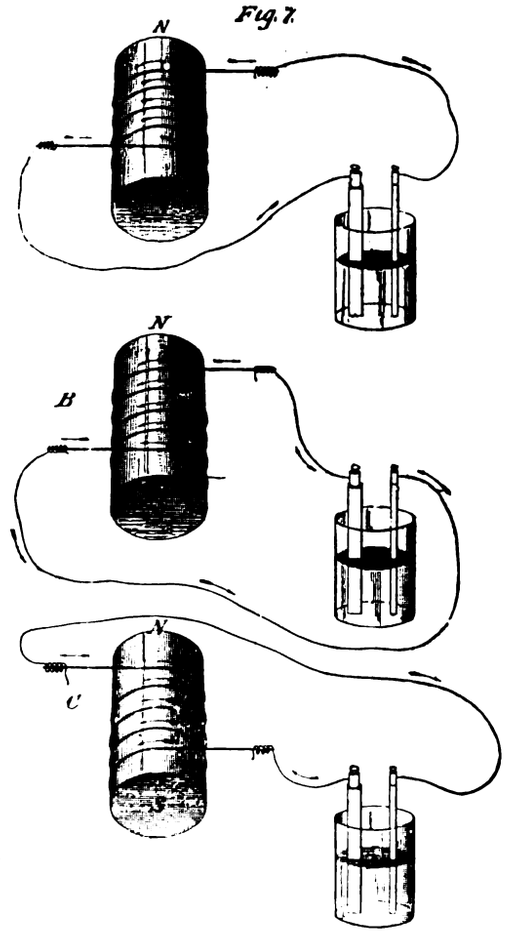
Fig. 6.



to flow in the direction of the motion of the hands of the clock; in this case, the farther extremity of the bar becomes a *North seeking* pole, while the nearer extremity becomes *South seeking*. The direction of the current, and consequently the polarity of the bar, may be reversed by joining up the *opposite* electrodes of the battery (or other source of electricity) to the ends of the wire coiled round the bar, as shown at *B*; where, as the wire

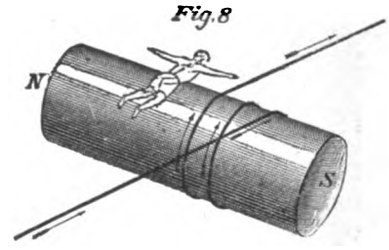
Fig. 7.



s joined to the electrodes in a manner just the reverse to that shown at *A*, so also the current enters at the opposite end of the wire, and produces contrary magnetic effects. The same result may also be attained by coiling the wire around the bar in the contrary direction, while leaving the connection with the electrodes unchanged, as represented at *C*. Perhaps the simplest means of remembering the relation which exists between the direction of the current, and the position of the magnetic poles produced, is one known as "Ampére's rule," in which the experimenter considers himself to be swimming head foremost, *with* the current, along the wire, *always facing* the iron core; *then* the *North seeking pole* will always be at his *left hand*, see Fig. 8.

§ 9. It must be borne in mind, as being of the greatest importance in the construction of successful dynamos, that although *steel*, or hard iron, when subjected to this inducing action of the current, becomes *magnetic*, yet it does not acquire nearly such powerful magnetism as soft iron; and, in fact, the softness of the iron, and its capacity for becoming powerfully magnetic, run side by side. On the other hand, it must not be forgotten as we learnt at § 7, that the softer the iron the sooner it loses the magnetism imparted to it; while the harder brands of iron (and more especially steel), retain nearly all the magnetism which it is possible to confer upon them.

Fig. 8



§ 10. The student who has carefully and intelligently performed the experiments described in the previous sections, will now find himself in a position to understand the principles which underlie the construction of the dynamo, even though he may have little or no previous knowledge of electricity. The first machine constructed after Faraday's discovery, was that of H. Pixii, in 1832. In this machine a powerful horseshoe magnet was caused to rotate rapidly before a soft iron *U* piece, wound with insulated copper wire, the two extremities of which were prolonged by two brass springs pressing against a rotating split collar of brass, whose office was to rectify the direction of the currents produced by rotation of the magnet, before the iron core; currents which, as we have seen in § 4, are in different directions, according to whether a given pole of a magnet is *approaching* to or *receding* from the core. This arrangement for causing alternating currents to flow in one direction, is known as the *commutator*, and it, or some modification of it, is most extensively used in all dynamos in which it is of importance that the current should flow in one direction only. The chief disadvantage in this machine was that of having to rotate a heavy magnet (built up of a number of thin steel plates), since the mere rotation tended to destroy, or at all events, to weaken its magnetism. In 1833 Mr. Saxton had the happy idea of fixing the heavier and causing the lighter portions of the apparatus to rotate; in other words, the magnet (or magnets) was now made a fixture, while the U-shaped soft iron armature, with its surrounding coils of wire, was caused to rotate rapidly before it, on axis or spindle, either by gear wheels or wheel and band. Mr. E. M. Clarke, in 1834, noticed that the *thickness* of the wire coiled round the armature had a considerable influence on the nature of the current produced by these machines. If the wire employed be very thin, say about the $\frac{1}{100}$th of an inch in diameter, and a large number of convolutions be coiled around the legs of the armature, the electricity produced is of high *tension*, capable of overcoming considerable resistances, and of giving severe shocks. If, on the contrary, a smaller quantity of a much thicker wire, say from the $\frac{1}{14}$ to the $\frac{1}{18}$ of an inch be made use of, the current produced is that known as a *quantity current*, or a "large" current, possessing but little power of overcoming resistances, not capable of giving shocks, but giving fine large sparks, and able to decompose water, and other chemical bodies. Clarke usually furnished two armatures with his machines, one wound with about 1,500 yards of covered wire $\frac{1}{18}$ in. in diameter, which he designated the "intensity" armature; the other, wound with about 40 yards of wire $\frac{1}{18}$ of an inch thick, to which he gave the name of the "quantity" armature. One peculiarity of the machines turned out by Clarke was the fact of the rotating U-shaped armature, being made to rotate near the flat *sides* of the magnet instead of *in front* of the poles. This, though it facilitates somewhat the mechanical arrangements, is open to some objections on the score of lesser efficiency, since the most active portion of the magnet is certainly *in front* of the poles.

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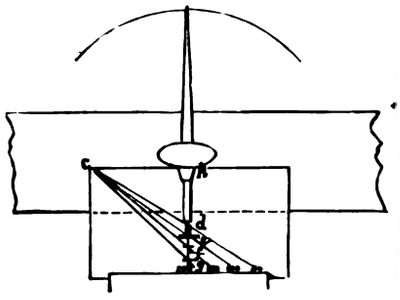
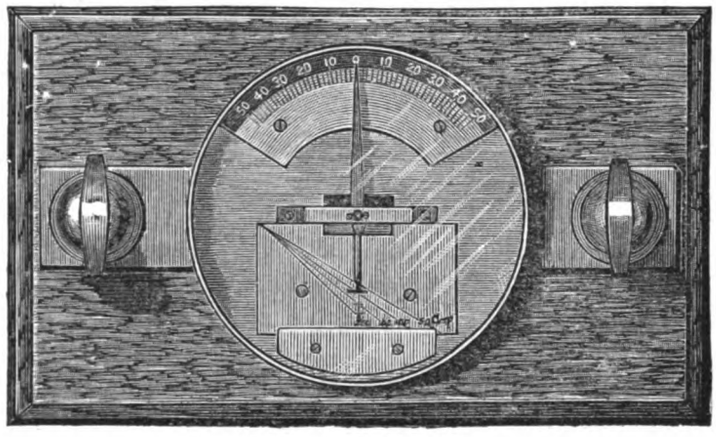
PATTERSON'S "ENGINE ROOM" AMMETER.

THIS galvanometer is designed as a cheap and effective current indicator for electric light installations for currents of five to 500 ampéres.

Instead of a coil of wire, a plain strip of 1x⅛ copper is used. The needle is short and oval, and it is found that the deflection of the pointer is exactly proportional to the current, excepting for the first degree or two above zero.

The pointer is counterbalanced by an arm capable of being lengthened or shortened. If the arm is shortened to its full extent, so that the pointer is very nearly balanced, a position may be found for the index so that a current of 50 ampéres will just mark 50 degrees on the scale. At its full extent it may take 200 ampéres or more to throw the pointer over to 50 degrees. And similarly, positions may be found where 100 or 150 ampéres will deflect the pointer to 50 degrees It is, therefore, only necessary to multiply the reading by 2, 3 or 4 in these respective cases. The limit of increase of the constant is the carrying capacity of the copper band.





The instrument is thus easily adjustable to serve for small or large currents. To show the amount to which the counterpoise has to be lengthened or shortened, a transparent vernier is provided, ruled on the lines going from a point, *c*, through the various points, *d*, *e*, *f*, *g*, where the index has to be to give the above readings. The intersections of these lines with the perpendicular, *h*, *g*, forms points on which the knife-edge of the index must rest.

If, however, the needle should lose its power in time (as all permanent magnets do), and it is desired to recalibrate the instrument, all that is necessary is to pass a known current of (say) 45 ampéres through it, and to shift the index of the counterpoise till the pointer rests at 45. The horn vernier or scale will then have to be shifted slightly to the right or the left till the point of intersection, of *c*, *d*, and the perpendiculars, *h*, *g*, is exactly under the new position of the index. The instrument is now in a position to take correct readings of small or large currents, as the new points of intersection on the vernier bear the same relation to one another in position as before.

The *London Electrical Review* states, that what is claimed for the instrument is:

1. Universality, in that it is serviceable for small or large currents.
2. Facility for taking readings, they being the same as the degrees on the scale or a multiple of them.
3. Easy calibration.
4. Simplicity of construction, which means a reasonable selling price.

We are informed that this apparatus is made by Messrs. Patterson & Cooper, of London, and adapted for any currents up to 2,000 ampéres, and that it is sold in England at £3 3s.

ELECTRIC LIGHTING.

OUR attention has been called to our article of last week by more than one party who consider that our remarks were somewhat severe. We believe we are entirely justified to the fullest extent in our remarks. We also believe that some of the advertising which is being done by parties in the city of Boston, to-day, is but little more creditable in actual effect than was that of Berney's Globe Company, which was so successfully squelched not many months ago. We have no intention of making any comparisons which are not just, and while we stated only the case that Edison had not done certain things we do not know that the New England, Weston or the Brush people have lent themselves to any such swindles as are now being perpetrated. We believe that there are gigantic frauds now in progress, and their home is in Boston. We referred to the Providence station last week as being closed up, while brilliant representations had been made of its opening, but the fact had not been stated that no lamps existed outside of the station. We also learn that the Springfield scheme has fallen through, parties there not desiring to go into stock speculation or to be manipulated. The daily press are still advertising a new company which is to be established pretty near our office, and we will further say, that when the United States Government can hire all the money they want, at 3½ per cent. we should look with distrust upon any concern, individual, corporation, bank, or otherwise, who attempted to advertise that they can make a dividend of ten per cent. upon a legitimate investment with legitimate management.

We have often said that large dividends, high rates of interest, big shaves on discounted paper, invariably meant poor security. We do not believe that the electric lighting company, now being advertised, can accomplish anything like the results they propose, and we believe, if the matter is closely investigated, it would be found to rest not upon substantial argument but rather upon stock manipulation. More than this we cannot at the moment say; but we will say that if the daily papers should pay half the attention to investigating and saving parties from being swindled that they did to the disgraceful hurrah which has just ended, they would certainly raise their tone and character as public journals rather than private corporations for sponging money, and would certainly save widows, children, and many people of small means from being swindled by men with an infamous history and a record which is, not by any means A1. Instead of this all of our daily papers are lending themselves to advertise a scheme which we believe will, if investigated, prove to have no foundation in fact as they are representing it. Electric lighting has not been a commercial success, with some exceptions. No company in Boston has made money to pay dividends from their earnings; it has been a cut-throat business for the last year and a half, and we do strenuously urge our readers to keep clear of these glowing advertisements, and let alone buying stock where the name of other people is used as having invested, without making the most diligent research into all the facts surrounding the case, and looking most closely into the actual status of the affair, from some other source of information rather than the parties who are manipulating the scheme.—*Cotton, Wool and Iron*, Nov. 17th.

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NEW YORK ELECTRICAL SOCIETY.

THE meeting of the New York Electrical Society, on Friday evening, November 16th, was well attended, and included a goodly number of persons prominent in various branches of the science of electricity.

After the transaction of routine business, the lecturer of the evening, Mr. S. P. Frier, manager of the Wheatstone Department of the Western Union Operating Room, was introduced, and read a very interesting paper on the "Wheatstone System of Automatic Telegraphy."

Mr. Frier began his subject with a brief sketch of all the automatic systems which have been and are now in use by the various telegraph corporations. Bain's system, which was invented in the year 1846, was the foundation of successive systems—good, bad and indifferent. This system was experimentally tried in this country in 1848–'49, but was abandoned for various reasons. An Austrian, Dr. Gintl, followed Bain with a system somewhat similar. In 1853 Siemens and Halske, of Berlin, bought an automatic process, and equipped lines in Russia with it. It was subsequently superseded by the Morse system. The difficulties encountered in this system, led to the introduction of the Siemens' polarized relay. This firm and others made innumerable experiments in automatic telegraphy, but not until the advent of the Wheatstone system was anything of a reliable nature produced.

"It was during a visit to Paris," said the speaker, "that, in watching the performance of a Jacquard loom (in which the threads are controlled by perforated paper cards), it occurred to Sir Charles Wheatstone, that if the mechanism of a loom could be so regulated, why not electricity? This idea," continued the speaker, "was immediately worked out, and in 1858 he took out his first patent for what is now so well known as the 'Wheatstone system.'"

Its working parts consist of a perforator, in which the paper is prepared for the transmitter; the transmitter, which uses the perforated paper for the purpose of transmitting the currents of electricity, and the receiver for recording upon paper the results of such electrical transmissions.

The speaker then described in detail each instrument, using diagrams to illustrate special parts of the mechanism not well understood by a mere verbal description.

The development of the Wheatstone system in Great Britain and Ireland during the past five or seven years, has been the most rapid of any system, and now all the circuits are worked at an average speed of 200 words per minute. It is growing in favor on the Continent. The Minister in Postal Telegraphy in France, has established at the central office a special course of lectures on Wheatstone's automatic apparatus, to which competent operators are admitted.

"One of the great uses to which this system is particularly valuable," said Mr. Frier, "is that of working extremely long wires. Experiments are at present carried on in working the system duplex, on a wire 1,000 miles long, through one repeater, and the speed attained is an average of nearly 150 words per minute—an equivalent to 600 messages per hour, 30 words per message. It is just a question of time when it will be working quadruplex. Like all other systems, that have for their object the disposal of many messages over one wire, the Wheatstone requires skilfull handling, and the repeaters have to be under the control of experienced electricians to obtain their full working capacity. A skilled mechanician is also an importatant requisition in this system. The Western Union have in their employ one of the best they could get from England. An other great advantage of the system is, that the paper for receiving does not require any preparation after leaving the hands of the manufacturer."

In conclusion Mr. Frier stated, that every town in England, which has a morning newspaper, has a Wheatstone circuit. London is the fountain head of the service, and an average of one million words per night are handled here. One punched slip will feed as many transmitters as necessary. These slips are often punched at once by the perforator, thus supplying matter for three separate wires.

There is no political, congressional, or other public meeting that has not a trained staff of Wheatstone operators. Every race meeting has its Wheatstone staff, without which, at such places as Epsom, Lincoln, Newmarket, etc., the business could not be handled—at the former on Derby Day, 5,000 or more despatches are handled within an hour or so of the result of the race.

A complete set of the apparatus, which had been placed on the platform for the occasion, was then put in actual working order, and examined with evident satisfaction and pleasure by the members. The scene was a lively one for a time, resembling a junior telegraph office. The beautiful workmanship displayed in the finish of the instruments elicited general expressions of admiration.

The next meeting of the Society will be held on Friday evening, December 7th, at which Mr. P. B. Delany, of Philadelphia, will deliver a lecture on "Synchronous Multiplex Telegraphy." This is the system recently invented by that gentleman, and given much publicity through the daily press.

RELATIVE COST OF THE ELECTRIC LIGHT.

THE following letter gives some information of interest relative to the cost of lighting mills with the incandescent system of electric lights:

OLNEYVILLE, R. I., Oct. 20, 1883.

Messrs. Rhode Island Electric Lighting Co., Providence:

GENTLEMEN—In accordance with your request, we give you below the result of our experience with the Maxim incandescent light.

On the third day of April last, we started one of your Weston dynamos, running one hundred Maxim incandescent lamps, and April 30th, an additional fifty-light machine. Our shop is a one story weave shed, containing 260 cotton looms, with attachments for fancy and Jacquard weaving, running on white work day and night, an average of 280 hours per month of lighting time throughout the year, or 243½ hours per month for the season just passed.

The power is furnished by the Corliss engine which drives our looms, our indicated H. P. being 50 without electric machines, and 73 H. P. with machines running. The shop was piped for gas with one seven-foot burner to every two looms, and additional burners in other parts of the shop, 167 in all. In stringing for electric lights we hung one incandescent lamp beside each gas burner, thus displacing only one gas jet by an electric lamp. The lamps were guaranteed for an average life of 600 hours. Since putting in the Weston machines we have run our 167 lamps every night, burning gas only during the stoppage of engine at midnight and morning, say a dozen burners one hour a day. We average the time of starting the two machines at April 15th, and reckon a full six months' average operation of the same—to October 15th—1,460 hours, the result of which is as follows:

Lamps broken in April. 9		Lamps broken in August...10	
" " May 8		" " Sept 9	
" " June.....7		" " to Oct. 15... 8	
" " July.....9			—
		Total.....60	

exclusive of 20 which were broken in starting the machines prior to April 3d, and 7 imperfect lamps which burned only an hour or two, and were returned for new ones. The time so far run is, in our judgment, too short to admit of an exact calculation of the actual life of the lamps. A breakage of 10 per month as above, if continued indefinitely in the future, would indicate an average life of nearly 17 months, say 4,000 hours. This we do not expect, but think we are safe in counting upon an average breakage of not over 18 per month of 243 hours, giving a life of 9 months or 2,200 hours.

Assuming the life of the lamps as 2,200 hours, we have as the cost of lamps per year of 3 360 hours, an equivalent of 255 lamps, at $1.50 each.....	$382 50
Attendance, 4 men, at $9.00 per week.....	468 00
Fifteen per cent. on cost of machines, shafting, belts, etc., ($4,328.00).....	649 20
Oil, brushes and sundry supplies, estimated.....	130 00
23 H. P., at 1 $\frac{85}{100}$ cents per H. P. per hour, for 3,360 hours.....	966 00
	$2,595 70

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Cost of gas, 167 seven-feet burners, 3,360 hours, 3,927,840 feet gas, at $2 per M.....	$7,855 68
In Providence we should be allowed a rebate on this quantity of gas, say 25 cents per thousand feet.	
Cost of electric lighting $\frac{46}{100}$ of 1 cent per lamp per hour, equivalent to gas at 66 cents per thousand feet.	

In the above figures we have charged to interest account an excessive amount, intended to cover depreciation and breakage. Up to this date we have had no breakage, and the machines are in better running order than when first put in. We have also charged to power the full proportion of the 23 H. P. used. We think it fair, however, to reckon against electric light only the expense of power in excess of what it was costing us before using the electric machines; inasmuch as we had our engine and boiler plant and the expense of engineers, supplies, interest, and the larger part of the fuel while using only 50 H. P. As most manufacturers are in the same position, the actual cost of adding electric machines to an existing plant of machinery would be, as regards power, much less than the proportion of H. P. added.

In our case we estimate the difference of cost per annum at not over	$500 00
Adding this to attendance, lamps and supplies as above.....	980 50
And 6 per cent. for interest on plant	259 68
We have.....	$1,740 18
which may be regarded as the actual cost per annum to us so far.	
To this should be added a depreciation account, say of 8 per cent., or.....	346 24
Or a total of.....	$2,086 42

which we believe to be a close estimate of the cost to us of 167 lamps, running or burning 3,360 hours per year, or ⅜ cents per lamp per hour, equivalent to gas at 53 cents per thousand feet.

The cost of several of the above items could be reduced largely by mills using larger engines and more electric machines. For instance the cost of power, in our case 1¼ cent per H. P. per hour, should be brought to less than 1 cent, while one attendant at, say $2.00 per night, could run 6 electric machines instead of 2 as in our case. The cost of machines, lamps and supplies will probably be reduced by competition as well as by improvements in the manufacture of the same, and there will doubtless be an increase in the actual duration of incandescent lamps.

We think it fair to state that we have a short circuit and a favorable one, with the dynamos placed in the same room with the lamps, and an easy load on our engine. Our running nights is also calculated to reduce the cost of the electric light to us. Our shop, however, is, on the whole, not an easy one to light, owing to the fancy heads on our looms and the heavy framework overhead for Jacquard attachments. We were obliged, in consequence, to use a large number of lamps for the area lighted, and the test against a seven-foot gas jet was a severe one for the electric lamps. We have had for six months a perfectly satisfactory light, with little trouble from any source; and as machines in actual operation every night during this time, we have no hesitation in saying that your Weston dynamos, with the Maxim lamps, have passed beyond the experimental stage and seem to us an assured success. We remain,

Very truly yours,

GRANT BROTHERS.

—— AN INDIANAPOLIS INVENTOR is said to be quietly laboring to perfect an electric headlight for locomotives, the power of which is to be equal to that of 400 candles. As a 20-candle light is the most intense that has hitherto been devised for this purpose, the prodigious gain of the invention, should it prove successful, is quite incalculable. It will light the track for a mile brilliantly, and the light will be full and continuous.—*Western Manufacturer.*

ELECTRICAL DISTANCE AND SPEED INDICATOR.

WE learn that the electrical mileage and speed indicators, manufactured by the Electrical Mileage and Speed Indicator Company, of Detroit, Mich., under patents owned by Mr. E. R. E. COWELL, of the same city, have been thoroughly tested on the Michigan Central Railroad with most satisfactory results.

The mileage indicator takes its motion from a magnet connected with the revolving axle by a simple cast-iron commutator and wires. As 480 revolutions of the forty-two-wheel, and 610 of the thirty-three-wheel make a mile, an exact measurement is made easily. The device is very simple but effective. Tested over a ten thousand mile run, not one mile was lost.

An electric signal, coupled automatically throughout the train, is another of Mr. Cowell's inventions, manufactured by the company above named. It is intended to supersede the bell-rope with its many imperfections and shortcomings, and has been aptly described as "the bell-rope of the future." No matter what the length of the train, it gives a perfect and instantaneous signal to the engine driver.

—— IT MAY CERTAINLY be said that for pumping, sawing, and such like operations of a large country house, an electro-motor, actuated by the dynamo which lit the house at night, would be much cheaper and quite as effective as a steam engine. Sir William Armstrong, at his place near Newcastle, has utilized a waterfall in his grounds to light his house by night, and supply it with power by day. The waterfall is 1,500 yards from the house, it actuates a turbine which it connects by a belt to a dynamo electric converter, capable of transmitting about five horse-power into a current of electricity. The current is conveyed by a suitable conductor to the house, where it works forty Swan lamps. In the daytime it works a sawmill. Sir William Siemens, at his country seat, near Tunbridge Wells, uses a steam engine, the waste steam of which warms the hot-houses. During the night the primary machines actuate two powerful electric lights, which are employed in forcing the growth of various fruits and plants which live, as it were, in perpetual sunlight—or its equivalent! During daylight one of the machines is used to work a chaff-cutter and other machines at the farm, a quarter of a mile away; the other does the pumping of the establishment. At night, of course, they are employed for light.—*Nineteenth Century.*

—— A DESPATCH FROM BOSTON, Nov. 17, says: Suit has been entered in the United States Circuit Court here by the Western Union Telegraph Company, the American Speaking Telephone Company, the Gold and Stock Telegraph Company and the Harmonic Telegraph Company against the American Bell Telephone Company, for violation of the agreement of Nov. 10, 1879. The complainants assert that under this agreement the American Bell Telephone Company was to enter into no more contracts with telephone exchanges and was to pay the Western Union Telegraph Company a certain percentage of rental or royalties on the patent then owned by the Western Union as soon as the use of the telephone reached a certain point. They claim that this point has been reached, and ask an accounting of all the property of the Bell Telephone Company, and an injunction restraining that company from further violation of the contract.

—— THERE appears to be a most prejudical feeling of jealousy—not commendable rivalry between some of the electric companies. Recent exaggerated and persistent attacks on the arc lights would seem to be inspired by something more than an excessive desire to protect the public from harm. Some papers have even gone so far as to attribute this animus to a leading electrician, and the entire anti-electric campaign to sordid motives. Electricians should know that such attacks must injure the interests of electricity in general. The public require to be familiarized with electricity, to regard it, as it truly is, as a great element of usefulness, and not as a mysterious death-dealing agency. "It's a vile bird that soils its own nest." Harmony and energetic action is what is required, not only in the interests of the public, but in those of electricians themselves.

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THE ELECTRICIAN.

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TO OUR PATRONS.

AT the close of another year and another volume, we desire to announce to our many readers and advertisers that the generous and hearty support we have received from them, and for which we are very grateful, has prompted us to make arrangements for the future conduct of this paper, that will greatly enhance its value and usefulness.

The new volume will appear under the more comprehensive title of THE ELECTRICIAN AND ELECTRICAL ENGINEER, it will be published by the ELECTRICAL PUBLISHING CO., and, as our friends will be pleased to hear, Mr. Frank L. Pope will hereafter be its editorial manager. The paper will be greatly improved, and will be as heretofore, absolutely independent and impartial on every subject. It is intended to make this journal more particularly the exponent of electrical science in this country, but at the same time it will give to foreign matters within its field the space and attention which their importance to American readers may entitle them to occupy.

Mr. Pope will bring to the editorial chair of this journal rare literary skill as well as ripe experience as an electrical engineer, and he occupies a high place in the ranks of that large and growing class, whose wants this paper will be especially intended to supply. Mr. Pope's experience as a writer for encyclopædias and other scientific publications, as editor of a telegraphic journal for many years, and as author of one of the best hand-books of telegraphy in the language, ensures the possession of the literary faculty in a high degree, while his services in the management of telegraphic enterprises at home, and in the Russian-American overland telegraphic expedition abroad, as well as the numerous electrical inventions he has made, show him to be equally familiar with the practical and technical details of his profession.

Starting in life as a telegraph operator, Mr. Pope was one of the first in this country to adopt and put in practice the results of scientific investigation, and he has since steadily maintained his place in the front rank of American electrical engineers and writers on electricity as applied to the useful arts.

We congratulate our readers on the many advantages which they will reap from Mr. Pope's connection with this paper. Address all communications to THE ELECTRICAL PUBLISHING CO., 115 Nassau Street, New York.

1883.

AS the flight of time reveals the future, it also affords a wider retrospect of the ever growing past. The harvest of scientific research and skilled industry has added much to the sum of human knowledge, and increased the blessings of life. More than ever has electricity become a necessity in what is essential, and a luxury among comforts.

While the records of the past year have not been graced by any wonderful achievements in electrical science, there have been numerous contributions to its advancement, resulting from the diligent efforts of numberless workers as yet unknown to fame.

The fertility of resource of the American mind is shown by the number of patents issued upon electrical subjects. The patents show constructive rather than creative skill, and if the record lacks those brilliant flashes of inventive genius, comparable to those which produced the telephone, yet there must be a modicum of good amid the rubbish of scores of useless patents, and the final result of such a great amount of honest application must prove beneficial. Who can state the measure of prosperity due to the liberal policy of our patent laws in fostering useful inventions; and some of our States have experienced the result of wise corporation laws, framed to encourage upon an equitable basis, the union of invention with capital.

Although a review of the electrical progress of the year is indeed a summary of the record of current events published in our columns, yet this affords an occasion to consider some of the salient features of the year's work.

On account of its novelty, the enthusiasm for its future, and the promises of success, electric lighting has claimed the greatest attention during the year, although the actual financial investments are less than those of the other commercial uses of electricity.

In all new enterprises, the prescient faith of the vigorous worker is an element necessary to success, but that phase of electro-mania, which seeks something for nothing, is pernicious to every interest involved.

The prosperity of electric illumination cannot rest upon a firm basis until divested of much of its speculative character. In the May issue, we showed that the capitalization of the 92 electric light companies in the State of New York, amounted to $122,445,000; and if the three or four leading companies are omitted, it is doubtful if these companies possess one million of dollars worth of actual property. In England, the business of electric lighting has been far more seriously embarrassed, by the extent to which speculation has usurped the field which would have yielded rich returns to legitimate business transactions.

If Adam Smith were in the flesh, rest assured that he would classify "promoters of undertakings" among the non-producers.

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Those not conversant with the details have little conception of the amount of toil required to bring the electric light to a commercial basis. Assistants had to be educated and artisans trained for this work; the market must be developed to furnish suitable supplies; and even it was necessary to invent and build steam engines to obtain desired results, and at this day, an American engine (Armington & Sims) is running the modern dynamos in the House of Parliament.

The question of engines for dynamos was considered of such importance, that much of our space has been devoted to an able series of articles on the subject.

The various schools of applied science are doing all that a technical school can do to furnish trained assistants in electrical science.

As an example of fine artisanship, we consider that the modern incandescent lamp is almost without parallel in the application of skilled handiwork to an article of manufacture. Consider the requirements, fashioning the material into a carbon filament, whose cross-section is certainly less than one five-thousandth of a square inch, yet the electrical resistance of each one must conform to a fixed standard, and be uniform throughout its length. The carbon must endure sudden extremes of temperature, and last for months while as hot as fused platinum; the vacuum must be the best attainable, the glass work comely, and above all, the whole furnished for the price of a very ordinary oil lamp.

Such success represents an unknown quantity of failures, and one wonders; could we draw aside the proper curtain, would not we see an incident similar to that of the valet of Beau Brummell, descending the stairs with a bunch of rumpled cravats, "these be our failures, sir!"

Among the textile mills, electricity has proven to be an ideal illuminant wherever the quality of the production made outside of the limits of daylight depends upon thorough illumination, exact discernment of colors, and the best physical condition of employés attainable by a pure atmosphere. But the small profits accruing from a large production of goods, has rendered the capital engaged in this business unusually timid, and exceeding conservative as to new expenditures, while sundry whispered expectations of new inventions of wondrous efficiency have tended to restrain purchasers.

No interest has so much at stake in the successful abolition of ærial wires as the electrical corporations, but no method of arranging subterranean arc light, telegraph or telephone wires has yet proven successful to the conditions that exist in New York.

Legislative stupidity has found frequent vent in enactments prohibiting ærial wires. Since it is an axiom of law that every wrong has a remedy, let these legal powers who put ærial wires under the ban, also show how to put them under the surface of the earth.

From time to time, we have given information respecting the efforts made in this direction, but the whole result is fairly stated in the last report of the directors of the American Bell Telephone Company.

"In the work of putting wires underground the progress has not been as satisfactory as could have been wished. Underground cables have been laid in iron pipes in Boston in two directions from the main office—one line being 1,200 feet, and the other 1,485 feet in length. Conversation is successful within short limits over these lines, but where they are used in connection with long lines—for instance those reaching to the suburbs—the voice becomes indistinct. Unless this difficulty can be removed, the connection with points outside of Boston would be almost if not quite useless to those whose wires were underground."

While great improvements have been made in electric lighting apparatus during the past year, no generically new line of development appears to have been taken up. Dynamo machines have been made more efficient and simplified in construction, arc lamps have been made more steady and reliable in operation, incandescent lamps have been improved in efficiency and durability, and many accessory devices have been developed and perfected which, in the aggregate, have largely increased the commercial availability of both systems of lighting.

Thus far, the effect of electric lighting upon the gas interests, has been of a beneficial nature. The fear of a competitor has encouraged the gas companies to adopt more modern processes, while the example of the thorough illumination in public places by electricity, has accustomed persons to greater artificial light, and increased the total consumption of gas about twenty per cent.

Experience has shown that the dividing line between electricity and gas is as strongly marked, as that between gas and kerosene oil.

As a result of strict attention to the continuous insulation of the apparatus, the electric light companies have not been compromised in matters of originating fires, during the past year, and the underwriters now consider a well arranged electric lighting plant as safe as any method of artificial illumination. It must not be forgotten that electricity, in common with all forms of energy, is dangerous in the measure that it escapes control.

Notwithstanding the large amount of threatened litigation on the subject, only two cases of especial importance have reached a decision during the year.

One decision set aside the Gramme patent, and was based mainly upon the principle that the expiration of a foreign patent terminates the United States patent for the same invention.

The other decision was to the suit of the American Bell Telephone Company against the Dolbear static telephone, and resulted in decreeing the injunction.

Should the Supreme Court upon hearing the appeal, decide that, in order to preserve the rights of Prof. Bell under the law, his invention covers all possible methods of electrical transmission of articulate speech, then his patent will be the broadest ever known, and embody the nearest approach which can be suggested to patenting a principle.

The Bell company is at present master of the situation, and the use of all improvements in telephony must be through this company. There are now 294,943 telephones leased in the United States, and the growing use of telephones will force the company to avail itself of every invention capable of improving the service in economy of time or material.

The telegraph is the factor which preserves the equilibrium of the commercial world; it traces the history of current events; and fixing prices by its record of supply and demand, performs service in nearly every transaction; and its absolute paralysis for a few hours would engender feelings of uncertainty and distrust, causing financial panic. For the extent of some of its operations, listen to the logic of figures taken from the report for 1883 of the President of the Western Union Telegraph Company:

Miles of poles and cables, 144,294; miles of wire, 432,726; offices, 12,917; messages, 41,181,177; receipts, $19.454,902.-98; expenses $11,794,553.40; profits, $7,660,349.58. Large as this amount may be, it is estimated that the Western Union represents only three-eighths of the telegraph in the country, the remainder being principally the wires in the service of railways.

There are now seven Atlantic cables in working order, and the average profit is said to be seven and one-half per cent., so there is reasonable ground for assuming that the two new cables will prove satisfactory to the projectors.

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The strike of the operators in July inflicted serious losses on both sides. Never was such an intelligent body of persons engaged in a strike, but the general public seemed to have little sympathy with any measures which interfered with the transmission of messages, and the strikers won a defeat. All strikes are to be deplored, and the question of the equitable compensation for labor of the various degrees of skill is a problem of civilization, which is more serious than that of slavery, in the measure that free labor is more valuable than slave labor.

The well-known physiological effects of electricity have given rise to many attempts for its general adoption, particularly for derangements of the nervous system; but its use is almost solely confined to the service of certain specialist physicians who are not professionally recognized by the medical fraternity. In the department of surgery, however, electricity has proved to be of great value.

We have had occasion to refer in terms of commendation to Leiter, of Vienna, Dr. Thomas Oliver, of Newcastle, England, and Dr. Roswell Park, of Chicago, for their services in using the incandescent lamps, in combination with specula, to illumine the interior of the body, and intelligently make diagnoses, which were formerly based upon mere conjecture.

Electricity has been used as a means of cauterizing; and of late, exquisites, dissatisfied with the growth furnished by nature, have availed themselves of electricity as a depilatory by cauterizing the follicles at the roots of the hair desired to be removed permanently.

Last year Prof. A. Graham Bell added to his fame by giving to the world a description of the beautiful adaptation of Prof. Hughes' invention of the induction balance used for the detection of masses of metal in the human body.

This apparatus was evolved from the imperfect device used to seek for the bullet in the body of the late President Garfield.

The science of electricity is becoming the handmaid of other sciences in matters requiring precise operation and accurate record; even the United States Fish Commission use the electric light in their investigations of the fish along our sea coast.

The improvements in the management of the light, have enabled photographers using the electric light to obtain the finest artistic effects. In the matter of electric watchmen's clocks, used by all large establishments, this country is certainly ahead of our transatlantic neighbors, where we believe the primitive methods of the pin clock are still in vogue, with all the possibilities of erroneous record, and sophistication by the unfaithful.

In the terminal railway stations, the signals for starting trains are given by an automatic signal apparatus, which is adjustable not only for a regular time-table six days in the week, but remembers the seventh according to the special schedule in use on Sunday, and also notifies gatemen to be at their posts, and passengers to leave the waiting rooms in due time for the departing trains. The telegraph and the automatic signals are essential to the safe operation of railroads.

In the matter of electric railways, operation has thus far been limited to experimental work in this country; but there are several electric railroads under construction, and the results of their operation will be recorded in due time.

Electro-motors have been thus far a matter of hopes and promises; there has been no electro-motor made which will automatically regulate itself to uniform velocity with variable mechanical resistance, and slight differences in current.

It is not unreasonable to demand of an electro-motor the same precision of operation which is required of a steam engine or water wheel. It is impossible to relate in the compass of a single article, the numerous uses to which electricity has been originally put during the last year, and in many an obscure device undoubtedly lies the germ of inventions which will prove a necessity to mankind, and we trust all useful inventions will bring adequate reward to their originators.

The literature of the heavy currents used in electric lighting, and all that pertains to the subject, scarcely made a beginning until the present year. Many of those, whose professional duties lay urgent claim for their services have imparted of the wealth of their experience.

Among the numerous contributions to the literature of electricity it cannot be considered an invidious distinction to refer to the Cantor lectures, delivered before the Society of Arts, by Prof. Sylvanus P. Thompson; and the lectures on electro-motors and their government, by Prof. Ayrton and Mr. Perry, as examples of clear statements of the present state of the art of using electric currents on a large scale. In the matter of electric literature, we are largely the debtor of our foreign friends.

Unfortunately, the contributions of such men as Prof. Henry Morton, or the inventors of the four great systems which are justly named after Brush, Weston, Edison and Thomson, are limited to a hasty interview, or a lecture which is general in its nature. It is to be hoped for the sake of the advancement of electrical science, that these gentlemen will give to the world the results of their experience. Each of them in his own way has attained to eminent success, and there is naturally a disposition to learn of the processes in the advancement of their work.

On the other hand, when examining many of the superficial productions, teeming with lax statements, illogical in method, and too often lacking in good faith, one thinks of the mentor of years gone by, and longs for one hour of Michael Faraday.

The Vienna electrical exhibition introduced many tasteful matters of improvement, but it seems to lack the importance of the electrical exhibition previously held at Paris.

Careful preparations are in progress for the electrical exhibition, to be held under the auspices of the Franklin Institute, at Philadelphia, in next September. We commend it to our foreign friends as well as to our home readers, and trust that the exhibition will receive the co-operation of all interested in electricity.

About forty years ago, one of the principal examiners in the United States patent office, came to the mature decision that the work of the patent department must soon come to an end, because the inventive power of the human mind had reached its limit, and that there would be no further demand for new inventions. So, like a prudent man, he resigned, and engaged in portrait painting, which promised to be a good business to the end of time while vanity and funds kept company with humanity.

The marvelous growth of the American patent system is not merely the result of wise legislation, but an indication of a national trait which is doubtless the evolution of the economies rendered necessary by the privations of the early settlers of our country. Our patent system has outgrown the scheme of a generation ago, and the inventive interests require modifications which would reduce the amount of litigation necessary to enforce the title to disputed inventions. Although the time has passed when a judge on the bench could be deceived by an inverted planing machine, as was the case in one of the Woodworth suits, yet it seems proper to assume that many questions of fact could be more feasibly established before a tribunal, consisting of persons familiar with the class of

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invention in dispute, than before judges learned in the law, but whose education in mechanics is too often carried on in the court room.

The opportunity for new inventions extends as the demand for greater consumption grows. The development of one invention gives rise to a demand for others. We have already referred to the needs of methods of governing electromotors, and to the desirability of some arrangement of protecting underground electric conductors.

At a recent meeting of the New England Cotton Manufacturer's Association in Boston, the burden of the session was not devoted to questions of mechanics or mill-engineering, neither did the financial problems of cotton manufacture receive attention, but the published reports show that the most serious consideration was given to the difficuties which beset cotton spinning during dog days. It is well known that this hindrance is caused by the accumulation of the static electricity generated in he action of the fibres on each other, and by the belts; and is not confined to cotton mills, but is shared to a greater or less extent by all textile mills. During these peculiar atmospheric conditions, the quality of the work is lowered, and the quantity of production reduced from six to eight per cent.

This meeting was attended by representative men in every branch of the cotton manufacture, and with their experience—upon a problem so serious, that one member made the statement that its solution would be worth millions to American mills—there was no method shown by which these difficulties could be overcome. The use of atomizers or vapor to control the humidity of the atmosphere, or the use of electrical conductors at belts, give only partial results. We referred to the matter at some length several months ago, and commend it as a subject which has received but little attention from skilled electricians, and is full of promise to the one who masters the subject and devises the means of preserving those atmospheric and electrical conditions most favorable to textile manufactures.

The necrology of the year shows that death has been busy, and that some of the leaders in electrical science have been called to their final rest.

This article does not afford an opportunity to give a fitting reference to Sir Karl Wilhelm Siemens, perhaps better known by its anglicised form, Charles William, eminent as a scientist, civil engineer and electrician, and like Michael Angelo, successful in the many enterprises and lines of study to which he devoted himself. Coming from Germany to London, at the age of forty years, his wonderful attainments placed him *primus inter pares*. He was recently invested with Knighthood by Queen Victoria, being one of the few persons foreign to British dominions, who have been thus honored.

Of the other more prominent electricians who have passed away, one of the oldest was William Martin, of Boston, who was an associate of Prof. Morse in constructing the first galvanic telegraph, and retained his connection with the Western Union in a position of responsibility to the last.

W. E. Sawyer, one of the earlier lights in electrical science, closed his life in a shadow of marked contrast with the earlier promise, justified by his brilliant scientific genius.

The death of Mr. Cromwell F. Varley, in England, was flashed through the submarine cables whose practical and commercial operations were more due to his electrical skill, than to any other single person. Richard S. K. Werdermann devoted himself to electrical science in such an unselfish manner that he did not provide a suitable competency for those dependent upon him.

M. Alfred Niaudet, a prolific writer, manager of the Societe Générale des Téléphone, and chairman of the Compagnie Internationale des Téléphones, of whom our excellent contemporary, *Révue Industrielle*, says:—"He was one of the first to foresee the part that would be played by machines in the production of electricity."

M. Brequet, a prominent electrician, member of the French Institute and of the Bureau of Longitudes, as also his nephew, M. Niaudet Brequet, a well-known electrician.

We forbear to mention others of lesser fame, whose talents have doubtless found suitable enconiums, and whose virtues received recognition by those of their personal acquaintance.

The limits of this review have estopped suitable reference to many features of electrical progress which must be considered of minor importance

Electricity is full of promise to any who choose to enter the faithful consideration of its principles, in their relation to the wants of man; and our object will be to continue a record of electrical success for

1884.

NOTICE.

IN our November issue we published a communication regarding the late K. S. R. Werdermann, of London, pointing out that he had left a helpless family unprovided for. Any who wish to contribute to a fund for their present relief may send checks to Clarence A. Seward, 143 Fifth Avenue, Henry Morton, Stevens Institute, Hoboken, N. J., Rowland R. Hazard, 173 Fifth Avenue, N. Y., Thomas E. Gatehouse, 22 Paternoster Row, E. C., London, England.

—— AT THE PRESENT TIME, electric conductors are continuous half way round the world, and whenever a message is sent from England to Australia, direct energy is transmitted 10,000 miles, but in what quantity? The energy of the current, according to Professor Osborne Reynolds, as it arrives, is not much more than sufficient to keep a watch going, at any rate not more than 1-1000 millionths of horse-power. The value of such energy, estimated at £17 per minute. would be equivalent to a billion pounds per horse-power per hour, whereas the highest price paid for animal labor in Australia or England is not more than 6d. per horse-power per hour. This shows the difference between the transmission of electricity for telegraphic purposes and its transmission for mechanical purposes. Energy differs in value greatly, but for operations that can be performed by men or horses, the price of energy must be regulated by the highest price of corn.—*Engineer.*

—— M. SAUER has constructed a battery that acts only in sunlight. The battery, as described in the *Electrotechnische Zeitschrift*, consists of a glass vessel containing a solution of 15 parts of table salt and 7 parts of sulphate of copper in 106 parts of water. Within is a porous cell containing mercury. One electrode is made of platinum, and is put in the mercury; the other is of sulphide of silver, and is placed in the salt solution. Both are connected with a galvanometer, and the whole is inclosed in a box when not in use. When the battery is placed in the sunlight, the galvanometer needle is deflected to a certain point, and the sulphide of silver is found to be the negative pole. Any change in the intensity of the light—such as a cloud over the sun—is indicated by the needle. The action of the battery depends on the effect of the chloride of copper upon the mercury. Sub-chloride is formed, and reduces the sulphide of silver; but this can only take place with the aid of sunlight. Hitherto the only manner in which light seemed to affect electrical action was by increasing the resistance of a selenium cell, and all photo-electrical experiments were based on this phenomenon.

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THE ALLEGED DANGERS OF ELECTRIC ARC LIGHTING.

"There is but one Edison and Johnson is his prophet."

[Extract from *Edison Bulletin*.]

A GENTLEMAN of Philadelphia, well-known in electric circles, has occupied himself for many years in making a collection of *bric-a-brac* mainly relating to electricity and its practical applications. Not the least curious and suggestive of these objects is a cutting from a Philadelphia newspaper of some fifty years ago, containing a most emphatic and earnest protest against the proposed establishment of a system of gas lighting in that city. A terrifying catalogue is given of the direful consequences which must inevitably result from the general introduction of the new mode of illumination. The waste products from the works would kill the fishes and annihilate the fisheries upon the Delaware and Schuylkill rivers; the gas would take fire within the pipes, heat them to incandescence, and thus produce a general conflagration; the pipes would continually be broken or become leaky, and the escaping gas collecting and taking fire, would give rise to the most frightful explosions, tearing up the streets, shattering buildings into fragments like gunpowder, and scattering death and destruction far and wide. If it did not take fire, it would suffocate people in the streets and in their homes, it would kill the shade trees in the streets and parks, and destroy birds and animals, and so on at great length. To this manifesto is appended the signatures of a vast majority of the leading citizens of Philadelphia of that date.

It must be admitted that these predictions have been found by experience to be justified by the results. Frightful explosions have been produced, buildings have been blown to atoms and set on fire, men, women, and children, to say nothing of beasts, birds and fishes, have been blown up, poisoned, or suffocated in great numbers, and vast numbers of shade trees have been killed; nevertheless it does not appear that there is any general disposition on the part of the public to abandon this death-dealing illuminating agent and return to the comparatively harmless whale oil lamps and tallow candles of the ancient Philadelphians.

The same class of alarmists have now selected the electric arc lighting system as an object of attack upon substantially similar grounds. During the past few weeks the public has been regaled with a series of highly sensational essays under such captions as the following: "Sudden Death in the Air," "Wires that Burn and Kill," "There is Death in the Box," etc. The writer of these articles commences by solemnly assuring the public that "conflagration and death are threatened by every inch of the big arc light wires, of which hundreds of thousands of feet are strung up all over the city. They are a constant menace to the lives of those who walk beneath them, and to the permanence of the stately buildings whose architectural beauties they veil and mar." It would occupy too much space to repeat in detail all the preposterous falsehoods and misstatements with which these articles abound, and which purport to be given on the authority of an anonymous "expert of world-wide reputation." It is perhaps fortunate for that gentleman that the writer does not state in what the expert's reputation consists, inasmuch as there are persons who might regard the President of the celebrated Sazerac Lying Club as "an expert of world-wide reputation." We have only room for a few choice extracts: "The wires are liable to kill, with lightning's suddenness and celerity, the fireman who directs a stream of water across them." The force of the arc lighting current is "sufficient to pierce a plate of glass half an inch thick." "The slightest touch of the finger of a child or servant or ignorant person upon a storage battery is punished by instant and certain death." "The storage battery is more hazardous than powder or dynamite magazines, so far as human life is concerned." These quotations might be multiplied, but the above are sufficient to show the character of the attack.

It is quite apparent to any one familiar with electrical science, that these articles are not written in the interest of the public by some well-meaning person who has been led into error by misinformation and lack of familiarity with the subject, but, on the contrary, they are inspired by some thoroughly well informed electrician with the deliberate design of misleading and alarming the public by a skilful admixture of statements more or less true, with deductions wholly unwarrantable and mischievous. Bearing in mind the fact that there are practically three systems only of electric lighting from a central station now in use, namely, the arc lamp, the incandescent lamp supplied by storage, and the incandescent lamp supplied by direct currents, and that in these articles the most virulent denunciations of the first two systems are coupled with a skilfully worded advertisement of the last, and the further well-known fact that the latter has wholly failed to achieve the commercial success which has attended the introduction of the former, the animus of the articles become apparent.

The truth is, as all unprejudiced electricians will admit, that arc lighting systems, like steam boilers, railways, gas-pipes, and hundreds of other necessities of modern civilization, may become exceedingly dangerous, when not properly supervised and controlled, but with the exercise of proper and reasonable care, the danger to firemen and the public generally, as well as to buildings and other structures from arc light wires, is practically inappreciable. The statement that persons may be killed, or even injured by electrified streams of water, and by electric currents transmitted through a wooden axe-handle, or through glass half an inch thick, are, of course, unqualified falsehoods which should never have been permitted to be published as facts in the columns of a reputable journal. The catalogue of persons killed and injured, is a short one, and consists, for the most part, of employes of the lighting companies, who are necessarily obliged to handle the apparatus and wires almost constantly, and who have suffered from the results of their own or their fellow employes' carelessness. No instance has ever been reported in which any person within a building, or the building itself has been injured by reason of arc light wires passing in front of it. No loss has ever been paid by the insurance underwriters, nor has any claim ever been made for damages resulting from arc lighting wires. Such attempts to injure the business of competitors by exciting unfounded alarm and prejudice in the minds of the public, cannot but ultimately recoil upon the particular interests they are intended to serve, with far greater severity than upon anyone else.

— SEVERAL MONTHS AGO, we gave publicity to the method by which one could obtain correct time from the astronomical observatory at Harvard University, Cambridge, at the price of a ten-word despatch at any Western Union telegraph office. At the present time telephone subscribers in Boston can obtain the standard time, as given by a circuit closer. The time is sounded in clicks, like the blows of a fire alarm. Thus, if four clicks were heard, and then six, the time would be six minutes past four. The expense of the matter has been borne by the New England Telephone Company, and all their circuits will be equipped with the novel feature, for the use of their patrons without extra charge, as soon as the apparatus can be placed in position.

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STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

IV.—ENGINES CAPABLE OF DIRECT CONNECTION.

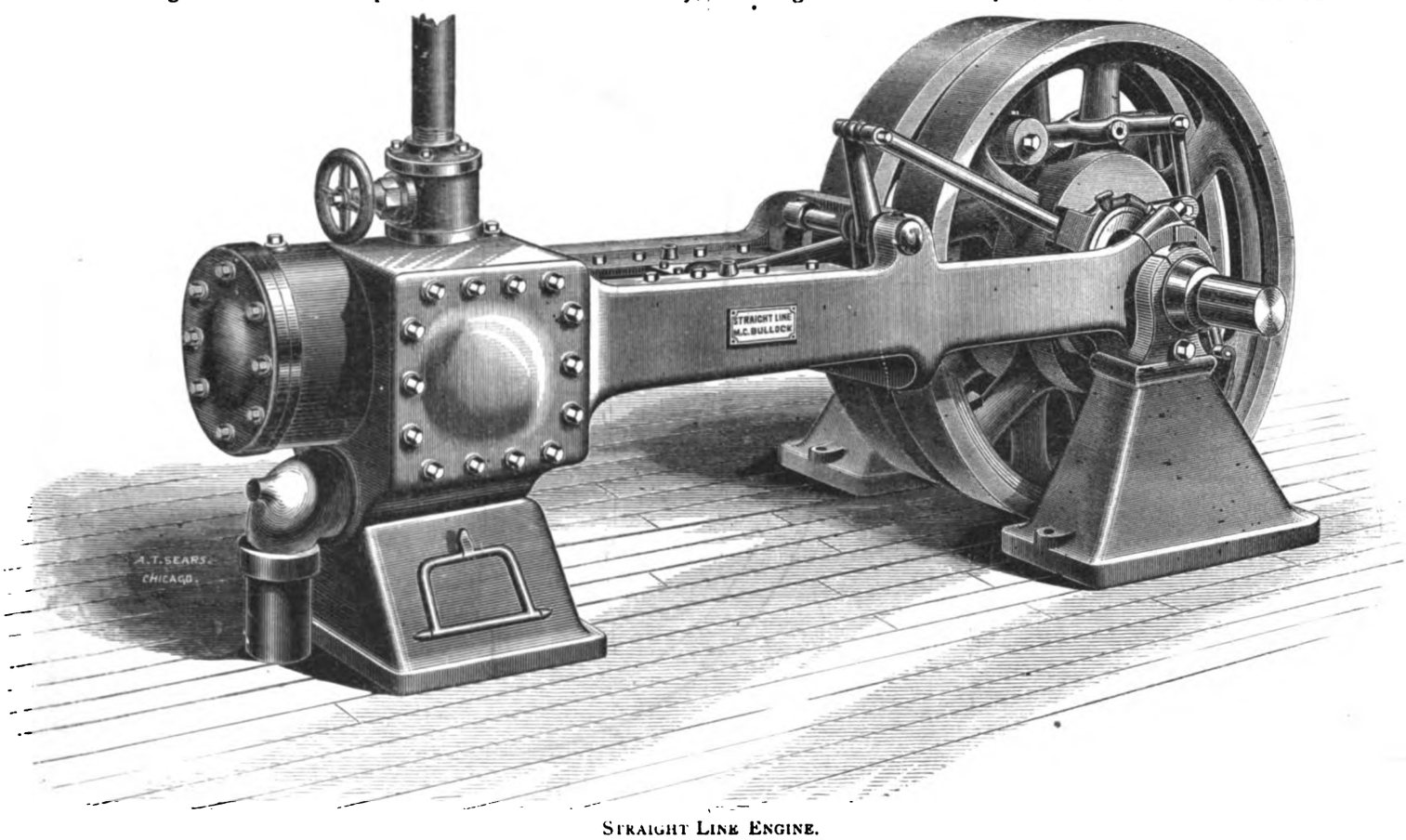
THE STRAIGHT LINE ENGINE.

REVIEWING what has been said in this section of engines capable of direct connection to the dynamo, it will be noted that the engines, which have now been described, have belonged to two classes, differing from each other in two very important respects. In the first, represented by the Porter-Allen engine, we find a form of engine especially, and very ingeniously, designed for high speed of rotation, fitted with four balanced valves, with the object of securing minimum "dead space," and maximum economy, and ease of working, and controlled by a governor which differs from the older form introduced by Watt, by several useful modifications of design, and especially, by being loaded in such a manner that its speed, and consequently, its power and sensitiveness in working, are greatly increased. In the second class, we find a valve-gear of the Meyer type driven directly by the eccentric, instead, as in the first class, through a link, and regulated by a governor riding on the main or the governor shaft, beside, and directly attached to the eccentric. The features essential to a "high speed" engine are also embodied in the second, as well as in the first class of engine.

We now come to the examination of a third-class of high speed engine, which differs as radically from the two preceeding as they from each other. In this new form of engine we find but a single valve which does duty both as a distributing and as a cut-off valve. A form of engine belonging to this class, with which the writer happens to be familiar, is that known in the market as "The Straight Line Engine."

This engine, so far as it is novel, is the invention of, and also is designed by, Professor John E. Sweet, formerly the superintendent of the workshops in which instruction in machine work was given in the Department of Mechanical Engineering of Cornell University—a position in which he became widely known as one of the most skilful and ingenious mechanical engineers in the United States—and now President of the American Society of Mechanical Engineers. The first of these engines was built at Ithaca for experimental purposes, by students, under the instruction of the designer.

The Straight Line Engine has many interesting and novel points, which will bear much more extended study than they can be given in the small space which can here be allowed for the description of the engine. The problem proposed to himself by the inventor, was to design an engine which, while consisting of the smallest possible number of parts, should, nevertheless, be economical in its use of steam, capable of the most perfect regulation attainable with any known device, strong and stiff in every part subjected to the working strains of an engine working at high speed, inexpensive in first cost, and durable as a simple engine can be.



STRAIGHT LINE ENGINE.

This engine is shown in the accompanying illustration.

A vertical engine, which is shown at the end of the article, is also designed for all powers; there seems no reason why it should not prove a good style for heavy work; better in some respects, in fact, than the horizontal engine

The engine takes its trade designation from its peculiar form of frame, which is seen to consist of two perfectly straight diverging struts extending from the end of the cylinder directly to the two main bearings, thus carrying the

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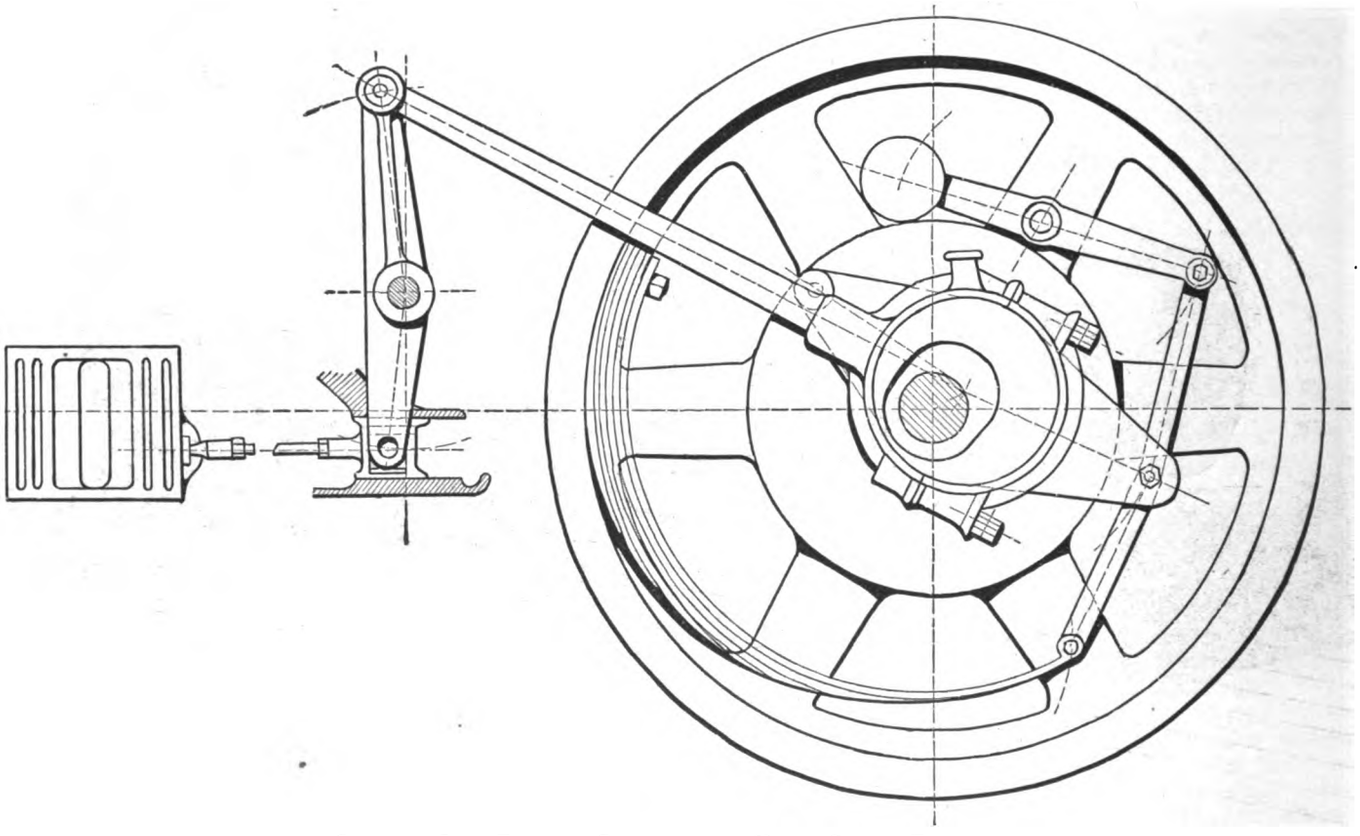
line of resistance to the pull and push of the connections exactly along its own central line. No possible arrangement could give greater stiffness with the same weight of material. The whole structure is carried upon three points of support, as is the practice with "surface plates," which must, if possible, have an absolutely definite and invariable system of suports, to avoid the slightest danger of "spring." These points are under the main bearings, and beneath the steam cylinder. The two journals receive equal loads; the crank-pin is not subject to the deflecting forces met with where a crank is overhung; danger of unequal wear of journals, and of springing the pin, is thus avoided very completely. The fly-wheel is placed in twin-form between the main bearings, and also serves as crank, thus making the best of cranks as well as balance wheel. This position of the balance wheel is one of peculiar advantage. By its action at this point, it intercepts heavy and objectionable stresses, which, in other engines, are transmitted to the main shaft; and the reciprocal action of counterweights and equilibrating parts is thus only felt within a mass of metal, which can resist them with perfect safety, and without their being felt in the more sensitive parts of the machine. This arrangement renders the main journal less subject to springing under the loads transmitted through it. To secure better distribution of wear, the crank shaft is allowed some end-play. This end-play, together with the carefully arranged system of lubrication, are the best possible insurance against excessive friction and wear.

The steam cylinder has the appearance of the cylinder familiar to every one, as seen on ordinary plain slide-valve engines. Its valve chest is placed at the end nearest the crank, and the ports and passages are carried as in those engines. The valve stems have no stuffing boxes, but pass into the chest through unusually long and carefully fitted holes in a hub, made about five one-thousandths of an inch larger than the rod inside the Babbitt metal bushing, for a length of six diameters or more. This hub is loose in the hole in the end of the valve chest, and packed at the ends by a washer fitted on a flat seat on the inside. The piston-rod is similarly fitted.

The crosshead is a very long casting which overruns the guide at each end at every stroke, and thus is rendered safe against wearing to a shoulder. A pin subject to reciprocating efforts in any part of an engine, whether it rotates, or carries a rotating or a vibrating piece, is apt, in time, to show wear on the two sides in line with the principal pull or thrust, and to lose its cylindrical form. In this engine, such wear is avoided at the crosshead pin, by cutting away the surfaces, which do little or no work, and thus securing overrunning surfaces, which are not subject to this distorted wear to so great an extent. Many other minor points invite attention, but they cannot be here considered.



STRAIGHT LINE ENGINE.—GOVERNOR AND VALVE GEAR. ELEVATION.

The principal feature of this design, in connection with that phase of its work which is of especial interest here, is its valve-motion. The valve is a rectangular block, sliding between the seat and a coverplate; is shown in the engraving. Ports are cut through the coverplate, through the valve, and through the seat into the steam and exhaust passages in the cylinder casting, in the proper positions. These ports are double at the ends of the valve, and a single port of ample area is made through the middle of the valve.

The valve is what may be called a "piston valve" of rectangular section, the space in which it slides having, therefore, also a rectangular section, and permitting the use of a detached coverplate, which, while sustaining the pressure of steam that would otherwise come upon the valve, and thus making it a balanced valve, nevertheless allows any unusual pressure, occurring when the piston comes back to the compression period of its cycle, to raise it, and thus to permit the water which may have caused the pressure

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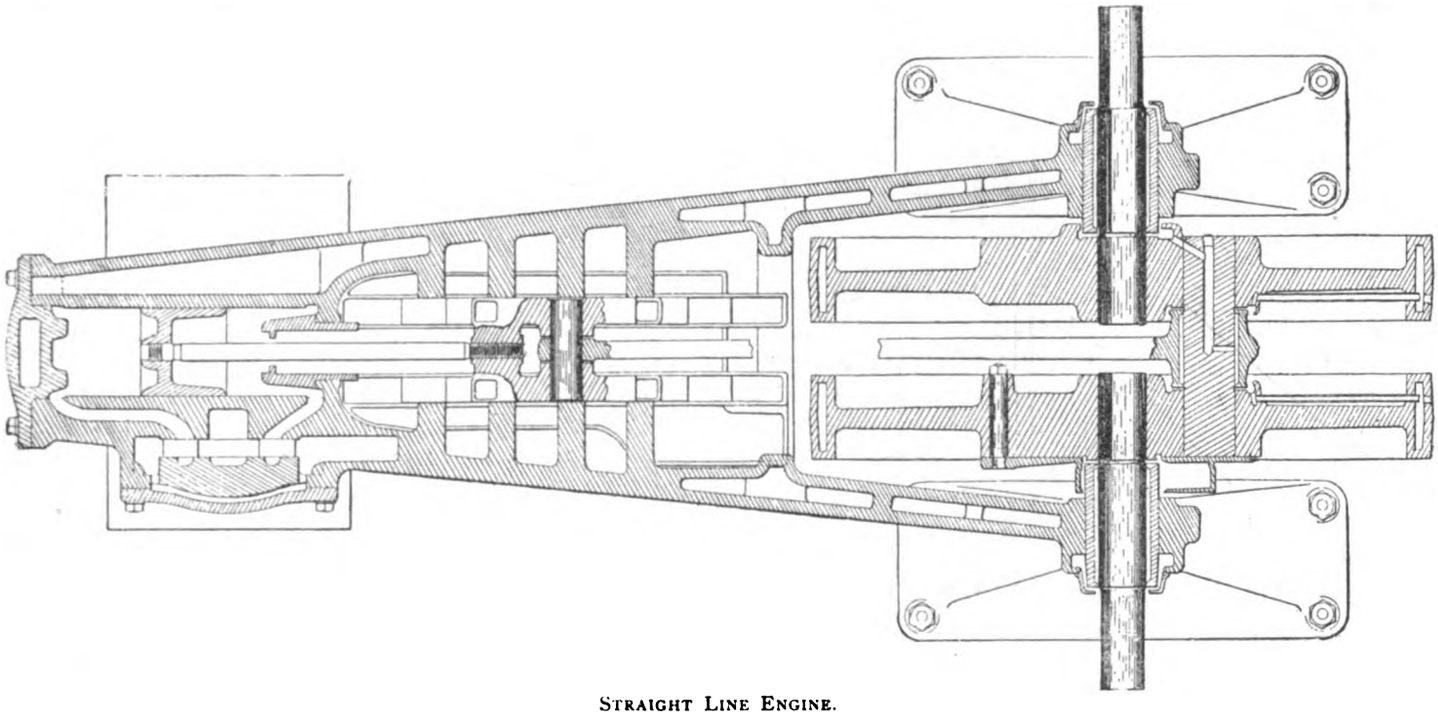
to flow back, and thus relieve the cylinder, and obviate all danger of forcing out the heads. The principal feature of this device is not new; the writer handled such a balanced valve on marine engines, rated at above 5,000 horse-power, nearly twenty years ago, and found them, so far as his own experience went, perfectly satisfactory. This new application of the principle, however, embodies some new and interesting points. The valve cover is sustained on loose packing strips, which are free to close up upon the edges of the valve, and to take up wear as it occurs. The form of the plate, its domed top, is such as to give it great stiffness against the superincumbent pressure, and thus to prevent pressure on the valve itself in consequence of spring in the plate, and the ports are so placed as to prevent the cutting away of the faces and seats by the rushing currents of steam.

The valve and cylinder ports are not dressed out; the casting is made so accurately that these edges can be left as they come out of the sand without loss of efficiency in the working of the valve.

The valve is driven by an eccentric, the motion of which is controlled by the governor, and the connection of which with the valve is effected by the peculiar system of linking, seen in the preceding illustration. The eccentric is so suspended from the disc, to which it is attached, that it may be thrown across the shaft by the action of the governor, in such a manner as to give the effect of the once common and well known "Dodd motion." It is carried on a lever, which is pivoted at one side of the shaft, while the governor rod is attached at the opposite side. The singular positions of the eccentric rod and the rockshaft arm enable the alteration of the throw of the eccentric produced by the governor, to be effected without alteration of the lead of the valve, so that the steam may be admitted, at all times, at the same point in the revolution of the engine. This it does, since the line of the eccentric rod is, at the commencement of stroke, in line with the lever on which the eccentric is carried.

The governor is similar, in principle, to those which have been described as used on the last type of engine. It consists of a single weight, or ball, carried on the end of a lever which is pivoted, near its middle point, on one of the arms of the governor pulley, and connected to the spring, by which it is held under control, by a link extending across to the other side of the shaft to the end of the spring, which is there secured to the rim of the pulley The action of the governor is substantially the same as that of those which have been already described. When the speed decreases, the tension of the spring, at the end of the weight lever, overcomes the centrifugal effort of the ball, and the latter is forced in toward the shaft, carrying with it the end of the eccentric lever, and thus giving the valve greater throw, and extending the period through which the steam follows the piston, producing more power and bringing the engine up to speed. The reverse change of speed of engine produces the opposite action of eccentric and of valve motion, and the cut-off is shortened, and the power of the engine is reduced to that needed to give the correct speed. As this governor may be made as nearly isochronal as may be desired, the approximation to correct speed may be made as close as is consistent with the sensitiveness considered permissible. The use of a single eccentric and of a single governor ball, and the general simplicity of this combination,



STRAIGHT LINE ENGINE.

are especially pleasing to the engineer. They, however, include the use of a single valve, and thus restrict the designer, somewhat, in his adjustment of the steam distribution, a restriction which the more complicated forms of valve-gear are constructed to avoid, as it is well understood that the economy of the machine, in its use of steam, is to a certain extent, dependent upon the method of distribution of the steam entering, and of the exhaust leaving the cylinder. The main objection is the fact, that the mean pressure of the steam entering the cylinder up to the point of cut-off is necessarily less with a single valve than with the gear introduced by Sickles and Corliss, and their successors, and which have been long standard, and which are admittedly superior in this respect. Whether the more costly, but more efficient gear shall be used, is to be determined partly by the cost of fuel, and must be settled by the judgment of an experienced engineer in each individual case.

The difference in this respect is not, however, as great as has been by some engineers supposed, and the economical value of heavy compression is now becoming so well

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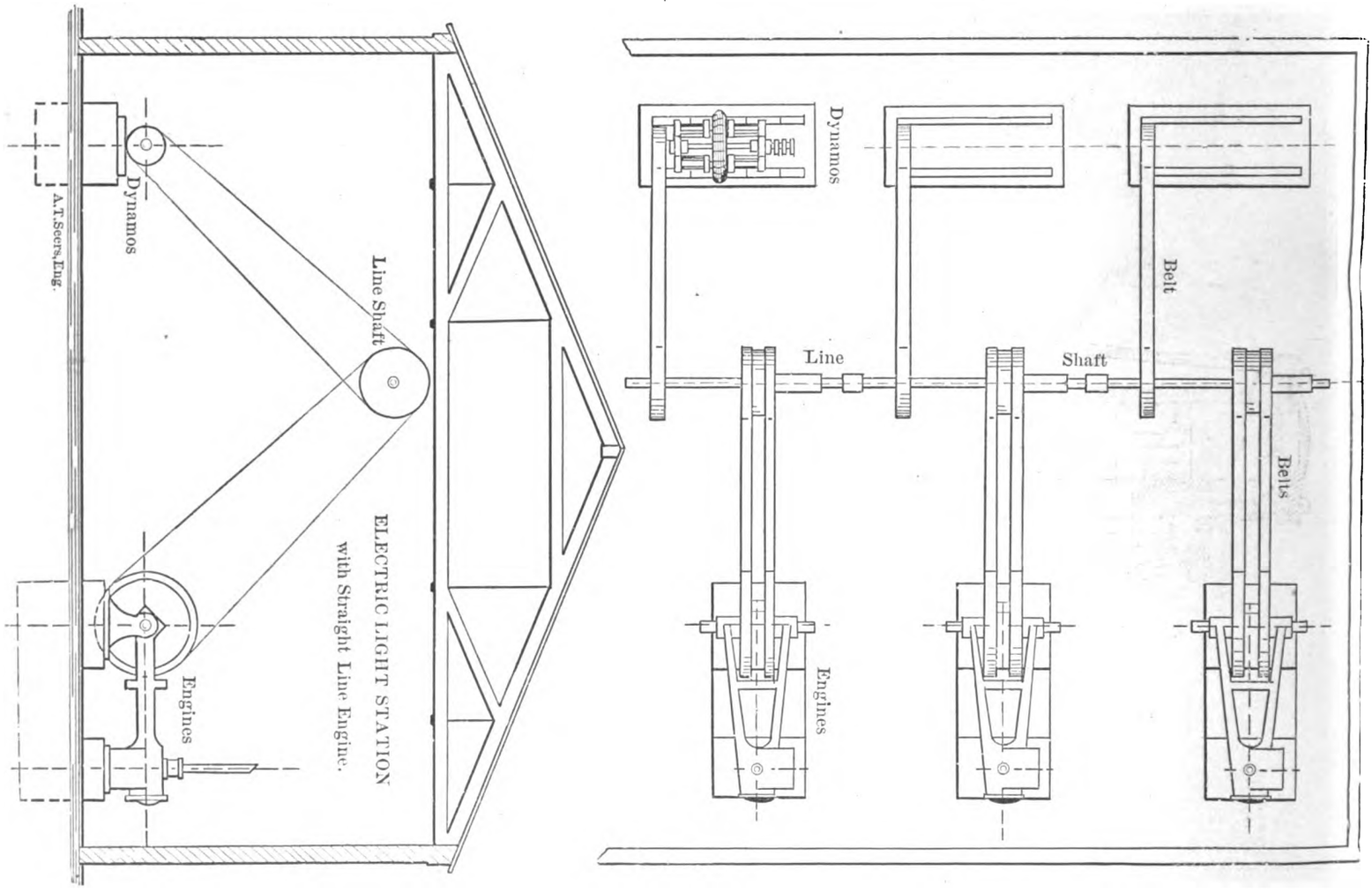
understood, that the general impression in regard to this system of valve motion is becoming considerably and rapidly modified. What is lost by the drop of pressure between the boiler and the piston, is partly compensated by the variable and automatically adjusted compression obtained with this kind of motion, as is well illustrated in the action of the Stephenson link as used on the locomotive. With this arrangement, there is also some loss at the exhaust period, but not usually enough to be considered serious. As this particular engine is operated, this latter loss, and possibly, to a slight extent, the former, are somewhat reduced by setting the valve without lead, or even with "negative lead," *i. e.* so that the engine does not take steam until the crank has just passed the center, and the piston is starting on the forward stroke.

crosshead, perfectly formed journals, and a valve gear and governor, which are as nearly frictionless as those parts can well be made. The growth of the engine into its present shape, from the first crude sketches made in 1869, to the finihsed engine and completed type of to-day, and especially the gradual evolvment of the governor and valve gear from the older forms, would be an interesting subject of study, but cannot here be undertaken. The survival of the fittest, among these devices, has led to the production of the engine above described.

The Straight Line Engine has been frequently applied to the driving of electric lighting apparatus. In Penney's arrangement of a station of 120 lights, the connection of power to dynamo is effected through friction clutches, which may, at any instant, be thrown



The engine, as a whole, with all its important parts in section, is shown in the above engraving. The unusual quantity of material as compared with earlier practice in older forms of engine, the excellent distribution of that material, the small number of parts, the heavy crosshead, the arrangement of fly wheels, and the form of valve are all plainly seen, as well as the general arrangement and system of connection. The rods and pins, and all running parts are made of steel; journals are ground to perfect form and polished, and the engine, when completed, is set up in the shop and carefully tried before sending it out, as is becoming the custom with good builders everywhere. The designer has made a special effort to reduce friction to a minimum, and has given the engine easy running piston and

out or thrown in; any two of the engines have ample power to drive all three of the dynamos used, and a reserve is thus supplied to be used in case of the necessity of throwing off one engine for repairs. The current from any one generator is capable of being switched into any circuit, and all parts are accessible for examination and repair. A novel device is that of placing the driving pulleys, on the main line, on separate hollow shafts, independently supported, to prevent the springing of the line shaft by the pull of the main belts. The line shaft runs directly through the jack shaft, carrying the driving pulley on the line.

As this engine is adjusted, with large compression when at regular speed, doing the rated work, with negative lead on

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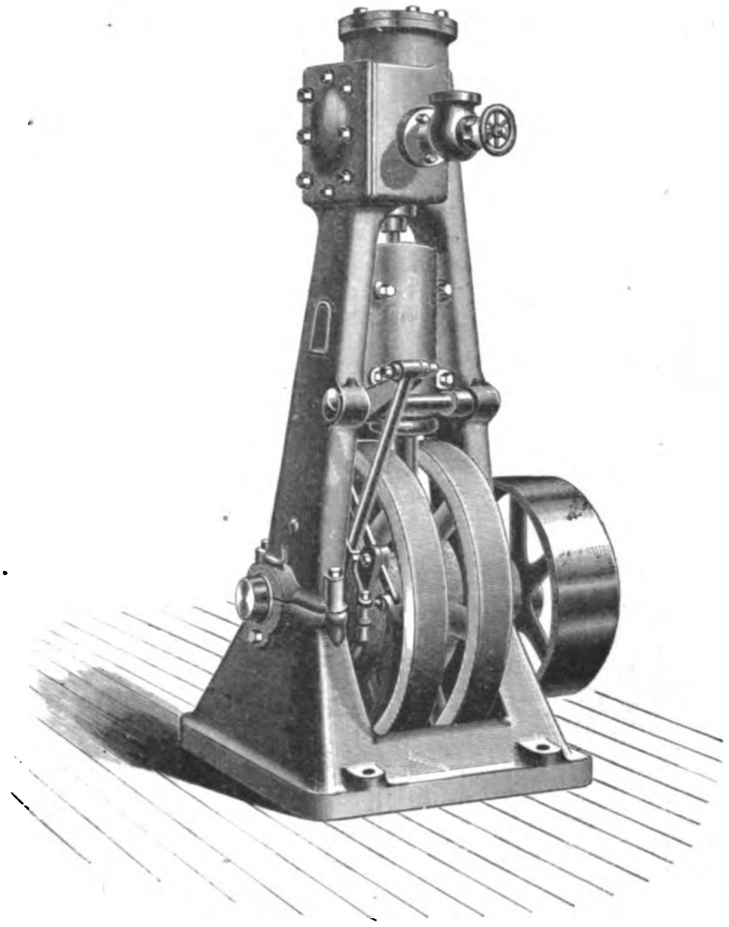

the valve at that point, becoming positive lead at ¾ cut-off, it illustrates well the efficiency of the class. A 50 horse-power engine, driving a 40 light dynamo, according to the report of the manager at the station, ran at 219 revolutions, and at 220 when 27 lights were thrown off. The writer, testing one of these engines, using a Prony brake to take up the power, counted 233 revolutions, light, and 232, loaded with above 40 horse-power; with lower steam, the figures became 231 and 230. A well-balanced valve and a nearly frictionless governor are the elements giving success here. Every good engine, driving dynamos, is probably expected to rival this, doubtless, but, doubtless many do not. The single-valve engine can evidently, as is here seen, be made, by a skilful engineer, to do excellent work.

—— A NOVEL APPLICATION of the science of photography to the art of gunnery has been introduced at the royal gun factories in the Royal Arsenal, Woolwich, by Col. Eardley Maitland, royal artillery, and some very successful plates have been taken showing defects in the bores of guns sent back for examination after trials. The electric light, powerful lenses, and mirrors are employed for this purpose. Minute flaws in the metal undetected by the usual gutta-percha impressions have been rendered clear to the eye by these photographs, and they are likely to prove of essential service.

—— MR. KELLINGWORTH HEDGES recently read a paper before the British Association on "The Fire Risks of Electric Lighting," which concludes as follows:—When the work has been properly supervised, no trouble should be experienced, and the electric light may be said to be much safer than gas, as it is free from those accidents which are due to a servant's carelessness, or by leakage of the pipes. Whatever danger there is with electric lighting, is entirely localized to the generating station, where the dynamos and engines would be under constant supervision.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

XII—ELECTRIC SPARK IGNITION.

PART III.—ELECTRICAL BLASTING.

ALTHOUGH so little difficulty was experienced in igniting vapors and gases by the electric spark, less volatile substances were at first only with great difficulty ignited. In one of his letters to the Royal Society, in 1747, William Watson says:[1] "I have made several attempts to light gunpowder, both cold and hot, but have not succeeded. That is because the powder gives off no inflammable vapor, and the same is the case with fulminating powder.[2] The electricity merely attracts and repels dry powder. But I have succeeded in igniting powder, and even *discharged a gun* by an electric spark, by mixing the powder with a little camphor or certain inflammable volatile oils." These experiments of Watson's initiated the modern art of electrical exploding.[3] It was soon found possible to ignite gunpowder directly by the spark; the essential condition of success in its ignition, and that of non-volatile substances generally appearing eventually to be the inclusion of a relatively poor conductor in the circuit. The advantage of introducing persons in the circuit in the firing of spirits, and the facility with which alcohol may be lighted by an icicle, being thus explained. "Conveyed by metallic conductors the spark passes in such cases with too great celerity to initiate the combustion.[4] Oblige the discharge to leap a *wide* air space; to traverse a long wet cord, or a foot or two of water in its circuit, and owing apparently to the retardation of its velocity, it will determine even a difficult ignition."[5]

In illustration, place some gunpowder between the poles of the apparatus, Fig. 90, called the universal discharger, and transmit through it the discharge of a Leyden jar. The powder will be scattered in all directions but not ignited. Next charge the small ivory mortar, Fig. 91, within which two conducting wires nearly meet, and including in the circuit 10 or 12 inches of water in a porcelain plate, repeat the discharge, when the powder will be exploded.[6] Placed, therefore in the open, wooden cup, devised by Sturgeon,[7] Fig. 92, gunpowder will always be ignited on receiving a spark from above, and so in any receptacle it will be usually fired by a spark from an icicle, because in the first case the wooden cup, and in the second the icicle, retards the discharge.[8]

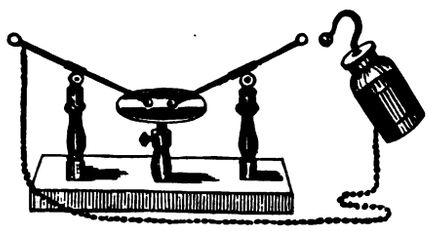

Fig 90.—The Universal Discharge.

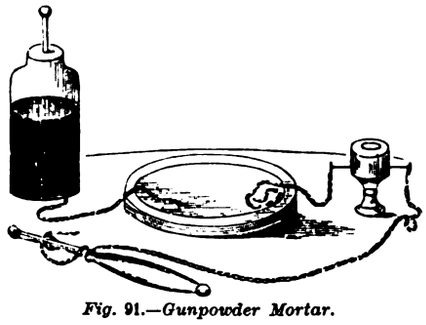

Fig. 91.—Gunpowder Mortar.

1. Watson. Loc. cit.; 3rd letter, p. 33-35.
2. Composed of nitre sulphur, and fixed alkaline salt.
3. They antedated by 3 years, the suggestion of Franklin, to which Gen. Abbott awards priority. See Abbot's report, 1879; p. 252.
4. Noad. Student's text book of electricity. London, 1867; p. 50.
5. Ibid, p. 50.
6. Ibid, p. 51.
7. Pepper. "Cyclopædic science simplified." London, 1869; p. 265.
8. Noad. Loc. cit.; p. 50.

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The ignition, by the spark, of gunpowder enclosed in a cartridge was probably first accomplished by Benjamin Franklin in 1750;[9] but not practically employed until Mr. Moses Shaw, of New York, fired a blast in the year 1831,[10] nearly a century later. Since then electrical exploding has become a special and intricate art. It has been found not only a convenience in the conduct of ordinary blasting operations, especially when nitro-glycerine or similar detonating explosives are fired in damp situations, but by its adaptability to the simultaneous ignition of numerous separate fuzes, either distributed throughout one, or in separate mines, it has rendered possible both industrial and military engineering operations on a scale of extraordinary magnitude which its development alone rendered feasible. Of these the first noted example was the cutting through for railroad purposes of the South Down Cliff, 400 feet high and 300 feet long, near Dover, England, by Mr. Cubitt, in 1843, when 400,000 cubic yards of chalk were detached at once by the simultaneous explosion of three separate charges of 18,000 pounds of powder each.[11]

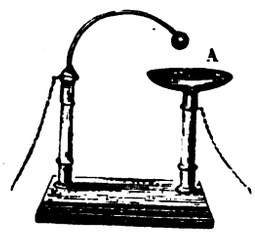

Fig. 92.—Gunpowder Cup,

Since the removal of the wreck of the Royal George, by Sir Charles Pasley, in 1839,[12] the first noted instance of the use of electrical ignition in subaqueous blasting, and the partial removal of the obstructions at Hell Gate, in 1851, by Mr. B. Maillefert, the spark has almost entirely superseded the expensive so-called "electric fuze," which necessity had so wonderfully perfected. But in submarine, as in overground engineering operations, either civil or military, by its applicability to simultaneous ignitions it has permitted the achievement of most remarkable operations. Of these, the successful blast at Hallett's Point, near Hell Gate, by General Newton, in 1876, when 3,640 charges of powder were simultaneously ignited, is the most notable example.[13]

The literature of electrical exploding is somewhat restricted and difficult of access, since its development has been effected chiefly by secret experiments of leading governments; but it seems decided that the progress of the art has been wholly dependent upon: 1st, the insulation of the conducting wires; 2nd, the construction of the fuze; 3rd, its priming, and 4th, the quality of spark employed. The first submarine cable being of cotton covered, copper wire, varnished with asphaltum and beeswax, originated with Col. Colt earlier than 1842.

In 1848, Faraday first recommended gutta-percha as an effective insulating material,[14] and almost immediately, as a vulcanized preparation, it was applied by the Electric Telegraph Company, of London, to the covering of conducting wires, being found especially suitable;[15] and long, almost exclusively, used for subaqueous conductors, though cotton covered paraffined wires, resembling Colt's early cables, are now often used.

Mr. Statham, Manager of the Electric Telegraph Company, discovering that the coating of sulphide of copper which lines the tube, left upon drawing a copper wire out of its gutta-percha covering, is a retarding conductor to an electric discharge,[16] devised the first typical electric fuze, which is even now frequently used, being simply constructed as follows: From a wire *c*, Fig. 93,[17] covered with gutta-percha the covering is partly removed, and the wire is bent double and twisted together. It is then cut through or interrupted half way between *c* and *c*, opened and a piece of old gutta-percha covering slipped over one end. The two ends being then brought in a line, the piece of gutta-percha is slipped over both, and a V shaped piece cut out of it from *a* to *b*, care being taken to leave undisturbed the internal coating of sulphide of copper it contained, which is left to form what is technically called a bridge between the two ends of the wire. If an intensity discharge be now sent through the wire, it will leave it at one end and leap to the other, along the bridge of sulphide of copper, but in so doing, will encounter so much resistance as to ignite the sulphide. Mr. Statham found that gunpowder placed in the cavity *a*, *b*, would be invariably exploded by an electric discharge. When, however, a number of fuzes were to be ignited, either in circuit or in multiple arc, it was found necessary to substitute for gunpowder a more sensitive priming; and Col. Verdä, a Spanish engineer, by thus using fulminate of mercury, effected a simultaneous explosion of six mines in circuit, at a distance of 900 feet from the operator, by the spark from a small induction coil. But the tendency of fulminate of mercury to corrode the ends of the wire, and other objections, rendered a different or more sensitive substitute desirable. Mr. Abel, aware of the conditions required, devised a composition which has been phenomenally successful, and served as a type for numerous later competitors. Abel's composition contains:[18]

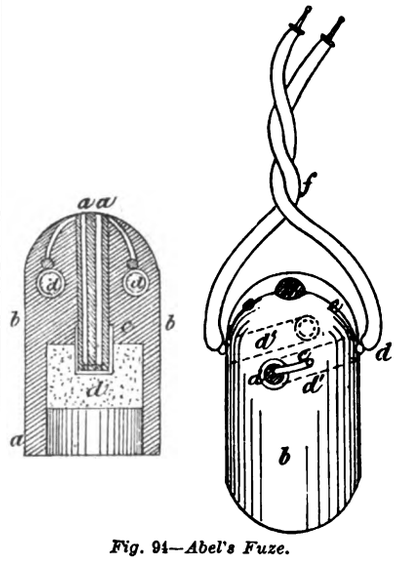

Fig. 94—Abel's Fuze.

Sub-phosphide of copper. 10 parts.
Sub-sulphide " ....45 "
Chlorate of potash.....15 "

The materials are, separately, finely ground, moistened with alcohol, well mixed, and applied as a paste between the copper wires; or first dried and then applied. When this priming is used no other bridge is necessary, as the sulphide of copper it contains gives the requisite degree of conductivity. Abel, therefore, in 1858, made a fuze,[19] by simply fastening two copper wires on opposite sides of the little block of wood with their ends projecting, and filled the space between them with the prim-

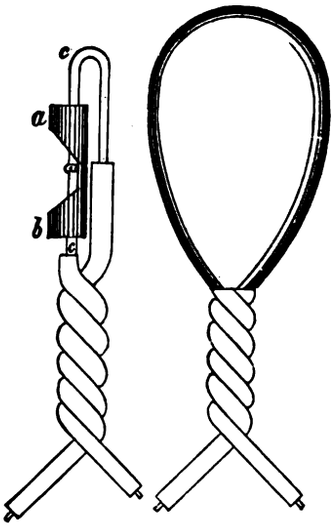

Fig. 13.—Statham's Fuze.

9. Franklin. Life by J. Sparks. Boston, 1856. Letter to Collinson, July 27, 1750; Vol. V., p. 223. Abbott. Loc. cit.; p. 252.
10. Abbott. Ibid; p. 252.
11. Encyc. Brit., vol. IV; p. 5. Abbott. Loc. cit. Also, Hutchinson, Lieut. R. E., Prof. papers, Royal Engineers, Vol., VI; p. 188.
12. Barnes, J. S. Submarine warfare, N. Y., 1869; p. 161. Encyc., brit. Vol. IV; p. 757.
13. Abbott. Loc. cit.; p. 244.
14. Faraday. Phil., Mag, Mch., 1848; XXXII, p. 165. Also, ex. res.
15. Faraday. Proc. Roy. Inst., January 20, 1854. Also, ex. res. p.
16. Noad. Student's text book of elec. London, 1867; p. 313.
17. From torpedoes and torpedo warfare. C. W. Sleeman, Portsmouth, 1880; p. 37.
18. Noad. Loc. cit.; p. 314. And Abbott, loc. cit.
19. Abbott. Loc. cit.; p. 200. Also, Sleeman, loc. cit.; p. 37.

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ing composition. This is the typical form of most of the numerous spark fuzes now employed, and its latest construction is shown in Fig. 94, as a result of considerable study.

(To be continued.)

THE ACTION OF THE DYNAMO.

BY LIEUT. B. A. FISKE, U. S. N.

Author of "Theory and Practice, or the Elements of Electrical Engineering."

PART I.

IN order to get a clear idea of the principles upon which the action of dynamo machines depends, it is necessary to first get a clear idea of the meaning of the term "potential," as used in electrical science. Potential may be briefly defined as power to do work; electric potential being due to electric force, and magnetic potential being due to magnetic force. As the idea of potential thus involves the idea of work, potential can be, and is measured in the same terms as those in which work is measured; *i.e.*, in ergs. An erg, as we know, is the unit of work, and expresses the amount of work expended in overcoming unit force through unit distance, as for instance, in raising a weight of one dyne through a distance of one centimetre. When the weight has thus been raised by the expenditure of one erg of work, it may be said to have unit potential, because, if liberated, it will fall, and in falling, do one erg of work.

To obtain an expression for electric potential, the supposition is made that a plus unit charge of electricity is forcibly brought up *against* the repelling force of a fixed charge of the same name, in the same way that a weight is raised *against* the attracting force of the earth. At length (supposing the fixed charge to be great enough) the work done will be one erg; work being, as we know, the product of force by distance. When our unit charge has reached this point, it has the power, if liberated so as to be able to obey the repelling force, of doing the same amount of work as has been expended upon it; therefore it has a potential, or power to do work, of *one*. In order to start with a plus charge out of the influence of the fixed charge, the supposition is that it starts from an infinite distance.

By the same reasoning, an expression is obtained for unit magnetic potential; the supposition being made that we forcibly bring up a plus unit magnet pole from an infinite distance against the repelling force of a fixed plus magnet pole, until unit work has been done. The point then attained is said to have unit magnetic potential, because a unit magnet pole, if placed at that point, would be repelled to an infinite distance, and so perform a unit of work.

The significance of "electric potential" may not yet appear manifest; but when it is recollected that the efficiency of dynamo machines is measured by the ratio of the electrical energy produced, to the mechanical energy expended, its bearing begins to become apparent, because we see that it gives a way of measuring what the electrical energy is. We have seen that a unit of electricity in falling through a unit of potential does one erg of work. Therefore Q units of electricity in falling through E units of potential must do $Q\,E$ ergs of work.

As an electric current consists merely of units of current falling through units of potential, and as we have instruments for measuring the number of units passing per second (ammeters), and instruments for measuring the potential through which these fall in a given circuit (voltmetres), we have at once a way of getting the electrical work done in any circuit.

As we know, the unit of current (or electro-magnetic unit) is not that thus far considered; but as the unit of potential used with it is based upon the principle that a unit of current electricity in falling through it does one erg of work, the product $Q\,E$ still gives in ergs the work done. As in practice the unit of current is $\frac{1}{10}$ this electro-magnetic unit, and the unit of potential is 10^8 times this unit of potential, the product $Q^1\,E^1$, in which Q^1 and E^1 are both practical units, equals

$$Q \times E \times 10^{-1} \times 10^8 = Q\,E \times 10^7.$$

Now as a kilogrammetre = 1000 x 100 x 981 ergs, we see that

$$\frac{Q^1\,E^1}{9.81} = \text{the work done in kilogrammetres.}$$

As a kilogrammetre per second = $\frac{1}{746}$ horse-power, letting C = number of practical units passing in one second (*i.e.* the strength of the current), we find that

$$\frac{C\,E}{746} = \text{horse-power in the circuit.}$$

From this the significance and the necessity of electric potential become apparent. To get an expression for potential as applied to magnetism, let us take a wire through which a current is passing, and put it through a little hole in a sheet of glass, which is covered with fine iron filings. The filings will arrange themselves concentrically around the wire, proving that the electric current in the wire has magnetic power. The same may be shown by passing such a wire near a magnetic needle. Electric energy and magnetic energy are evidently related, therefore, in some way; so that we may endeavor to get an expression for magnetic potential as related to electric potential.

In order to arrive at this relation, let us bend the wire into a loop. The whirls of magnetic force playing around the wire, will, in the interior of the loop, all lie parallel, so that they will combine in their action. If, now, we bring a magnet pole near this loop, it will be attracted or repelled according to the direction of the current, so that the loop acts like a magnetic shell, that is a sheet of magnetized material, in which the sides are oppositely polarized. Supposing the magnet pole to be a north pole, it will be noticed that it is *repelled* from a loop in which the current runs (as looked at from this north pole) in a direction *contrary* to that of the hands of a watch, and is *attracted* if the current flows in the *same* direction. For convenience of description, a current in the latter direction is called *positive*, the former *negative*.

It is a fundamental proposition, that the potential due at any point to a magnetic shell, is equal to the strength of the shell multiplied by the solid angle it subtends at that point. The potential at the surface of the shell must, therefore, be $2\,\Pi\,i$, in which i represents the strength of the shell, as the solid angle there is $2\,\Pi$.

If now we make a magnetic shell by looping a wire through which a current is passing, the potential in the plane of the loop will be also $2\,\Pi\,i$, in which i represents the strength of the shell produced by the current. In order to get the relation between this strength and the strength of the current, let us make the wire of the loop $2\,\Pi$ long; that is, make it in a circle of one centimetre radius. Remembering that the potential at any point due to a series of poles, is equal to the sum of the potentials due to all the poles, and that the potential at any point due to one pole is equal to the strength of the pole divided by the distance, we see that the potential at the centre of this loop must be $2\,\Pi$, multiplied by the magnetic strength of each centimetre of the loop. Remembering, again, that the force exerted by any pole is inversely as the square of the distance from the pole, we see that if we adopt the convention that a current of unit strength is one such, that if one

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centimetre of a conductor carrying it be bent into an arc of one centimetre radius, it will exert unit force at the centre, we can express the potential due to a closed voltaic circuit in terms of the strength of the current, by substituting, in the above proposition, "strength of current," for "strength of shell."

But here we must introduce the element of positive and negative signs:

It will be remembered that we found a north pole to be repelled by a negative current. As the north pole was thus repelled, it had a certain positive potential, or power to do work. Positive potential is, therefore, associated with negative current.

In applying the proposition, therefore, concerning magnetic shells to closed voltaic circuits, we must not neglect the signs.

The potential due to any closed voltaic circuit, therefore, is equal to the product of the solid angle it subtends into the strength of current taken with a negative sign.

If A equals this angle, and $+C$ is the strength of the current, the potential is $-A\,C$. The negative sign indicates negative potential, *i. e.*, not power to do work, but the reverse. In other words, the magnet pole is attracted, as it would be by a positive current. If the current were $-C$, then the potential would be $-(-A\,C) = +A\,C$; in other words, the positive magnet pole is repelled, as it would be by a negative current.

We must not forget, in all these cases, to look at the circuits from the position of the magnet pole.

(To be continued.)

EFFICIENCY OF ELECTRICAL MACHINES.

BY CARL HERING.

THERE are several statements made by electricians, in regard to the best distribution of the resistances in a circuit, but they apparently do not agree, and being frequently stated in an indefinite way, often cause considerable confusion. For instance, one engineer states that he can demonstrate mathematically, that, in order that a machine should have the greatest efficiency, the internal resistance must be made equal to the external resistance, because then the amount of work given off is a maximum, and says it is evident that the efficiency will be greatest when the amount of work given off is greatest. This has been published so often, that many accepted it, and built their machines accordingly; it is quite natural that they should be disgusted with scientific and mathematical statements, when they found that the greatest possible efficiency was less than 50 per cent., and that in many cases the machines became objectionably warm. Another engineer makes the statement, that in the above case, as the resistances were equal, the work lost in the machine will be equal to that done in the external circuit, as the work is done there where the resistances are, and that, therefore, the greatest amount of work obtainable from a perfect machine would be only one-half, or 50 per cent. of that used to drive it; but as many machines in use have a greater efficiency than 50 per cent., he says, that notwithstanding the mathematics, there is "something wrong" with the first statement. A third says, that as the work absorbed in a machine, and that given off in the external circuit, are respectively proportional to the internal and external resistances, that, therefore, the greatest efficiency is obtained when the internal resistance is made small, and the external resistance made larger. He also claims that he can demonstrate it mathematically; but as the first and last statements appear to contradict each other, and as they can both be demonstrated mathematically, there must be some fallacy in the statements, for what is mathematically true, cannot possibly be incorrect. An explanation of what these statements really mean, how they can be demonstrated, and with what limitations they should be applied, is the object of the present discussion.

Let E be the electro-motive force of the machine or battery.
$R_{,}$ the external resistance.
$R_{,,}$ the internal resistance.
R the total resistance.
C the current strength.
w the work in the external circuit.
$w_{,}$ the work absorbed in the internal circuit.
W the total work of the current.

The following will be evident:

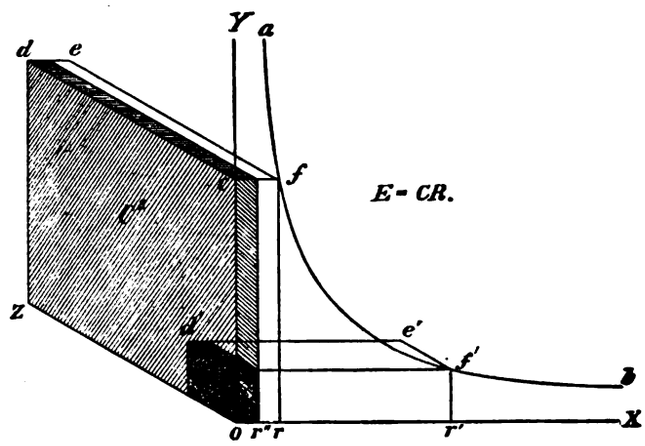
$$C = \frac{E}{R} \qquad R = R_{,} + R_{,,} \qquad W^{*} = CE = C^{2}R = \frac{E^{2}}{R}$$

As the work consumed in any portion of a circuit is equal to the resistance of that portion multiplied by the square of the current strength, it follows that

$$w = C^{2}R, \qquad w_{,} = C^{2}R_{,,} \qquad W = w + w_{,} = C^{2}(R_{,} + R_{,,})$$

w representing the useful work, and $w_{,}$ the lost work.

In order to examine the above mentioned statements, let us first see what the relations between the different quantities are, by representing them graphically, as that shows them much more clearly than algebraic formulæ.



In the diagram let the resistances be laid off on the line OX, and the current strengths on the lines OY and OZ (the latter being in perspective). From Ohm's law

$$C = \frac{E}{R} \text{ or } E = CR$$

which shows that if E is a constant, which we will assume at present, then the curve representing the relation between the corresponding values of C and R, will be an equilateral hyperbola. Let $a\,b$ be this curve, for the assumed value of E, then for any resistance, such as $o\,r = R$, the current strength will be represented by the perpendicular $r\,f = o\,c$. If the values of C be laid off on $O\,Z$ also, and a square constructed on the two as sides, its area will represent C^{2}, and if this is multiplied by the corresponding value of $R = o\,r$, then the solid $O\,Z\,d\,c\,e\,f\,r$, etc. will represent $C^{2}R$, or the total work of the current. If $o\,r''$ is the internal resistance, and $o\,r$ the total, therefore $r''\,r$ the external, then the two solids constructed on C^{2} will show very clearly the lost work (the shaded portion), and the useful work (the light portion), and what proportion one is of the other.

* As the factor "time" is not necessary in the demonstration, it will be neglected, that is, it may be considered unity; therefore the terms "power" and "work" can be used indiscriminately. *Volt-ampéres*, which really represent *power*, will therefore be called *work*, as it is thought that it will then be more easily understood.

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Let us assume a certain internal resistance, equal to $o\,r''$, and see what the different amounts of work will be for different external resistances, as $r''\,r$ and $r''\,r'$. It will be seen from the diagram, that as the external resistance increases, the *total amount* of work of the circuit becomes less, but at the same time the percentage of lost work decreases very rapidly, as $o\,r''$ remains the same; that is, the *efficiency is increased;* it is a maximum only when $R = \infty$ or $R_{,,} = 0$, neither of which are possible. When the external resistance decreases to $r''\,r$, the *amount of work* increases very rapidly, but as the internal resistance remains the same, the lost work also increases very rapidly, and the percentage of loss becomes much greater; finally, when the total resistance is equal to the internal, that is, the external $= 0$, the machine is short circuited, and all the work, which is then at a maximum, is consumed in itself, and appears as heat. It will be seen, therefore, that for a constant value of the internal resistance, and a decreasing external resistance, the amount of work will increase, but the percentage of loss also, the latter more rapidly than the former, from which it follows, that for a certain value of the external resistance the *amount of useful work* is a maximum; this is, as will be demonstrated, when the internal is equal to the external, as drawn in the diagram, in which $r''\,r = o\,r''$. As $O\,Z\,d\,c\,e\,f\,r$, etc., represents the total work, and the shaded portion the lost work, it follows that the useful work $W - w$, is equal to $\frac{1}{2}\,W$, or in other words, *when a theoretically perfect machine is converting the greatest possible amount of work into useful work, its efficiency is only* 50 *per cent.*, and as much work is converted into heat in the machine itself, as appears as useful work outside. From this it may be seen, that when an inventor claims that with the above arrangement of resistances, he has obtained 70 or 80 per cent. efficiency, he is, to put it in mild terms—mistaking.

The diagram also shows that the work depends very much on the position of the curve, but this depends on E, and becomes flatter, and moves upward and to the right as E increases. No change of E, however, will change the efficiency.

The mathematical demonstration of what was illustrated in the diagram, is very simple. As

$$w = C^2 R_{,} \text{ and } W = C^2 R$$

$$\text{efficiency} = \frac{w}{W} = \frac{R_{,}}{R} = \frac{R_{,}}{R_{,} + R_{,,}}$$

That is, *the efficiency is independent of E; it depends only upon the ratio of the external to the total resistances*, and can evidently be increased by increasing $R_{,}$ or diminishing $R_{,,}$. As

$$w = C^2 R_{,} \text{ and } C = \frac{E}{R} = \frac{E}{R_{,} + R_{,,}}$$

therefore,

$$w = \frac{E^2 R_{,}}{(R_{,} + R_{,,})^2}$$

which by the aid of calculus can be shown to be a maximum when $R_{,} = R_{,,}$. To prove this by algebra, solve the equation for $R_{,}$ which gives

$$R_{,} = \frac{E^2}{2\,w}\left(1 + \sqrt{1 - \frac{4\,R_{,,}\,w}{E^2}}\right) - R_{,,}$$

from which it can be seen that the greatest value which w can have for real values of $R_{,}$ is when it makes the quantity under the radical 0, that is, when

$$1 - \frac{4\,R_{,,}\,w}{E^2} = 0$$

or

$$w = \frac{E^2}{4\,R_{,,}}$$

substituting this value of w in the value of $R_{,}$ gives, after a simple reduction,

$$R_{,} = R_{,,}$$

that is, w is greatest when the external and internal resistances are equal. But as $R = R_{,} + R_{,,}$ this value of $R_{,}$ makes

$$W = \frac{E^2}{R} = \frac{E^2}{2\,R_{,,}} \text{ and } \frac{w}{W} = \frac{E^2}{4\,R_{,,}} \div \frac{E^2}{2\,R_{,,}} = \frac{1}{2}$$

that is, the efficiency is then 50 per cent.

The above discussion is applicable only when there is no counter electro-motive force in the external circuit. When there are electro-motors, accumulators, electro-plating baths, etc., in the circuit, developing a reverse electro-motive force, the statements must be changed slightly. This case will be discussed in another article.

To recapitulate: for a given total resistance the *efficiency* of a machine is increased as the ratio of the external to the total resistance is increased; and for a given internal resistance it increases rapidly with the external resistance; it is a maximum, that is, unity or 100 per cent., only when the internal resistance is 0, or the external ∞, and the machine a perfect one. The *greatest amount* of work obtainable from a machine, is when the external and internal resistance are equal, and then it is only one-half of the work used to drive it. In both cases the *total work increases with the square of the electro-motive force*, but the *efficiency is independent of the electro-motive force.*

These statements are not contradictory, as might be at first supposed; for instance, if we wanted a machine to do a certain amount of work, we would select one capable of doing much more than the required amount, and by making the external resistance high, use only a part of the work it is capable of furnishing, and thus obtain a higher efficiency. As the price increases with the size, and at the same time the percentage of loss decreases, the question of how powerful a one to choose, depends upon so many quantities, that it would be impossible to calculate the limit theoretically. Having given the constants, dimensions, and price of each machine, and the cost of the power, any electrical engineer can make the necessary calculations, to show which one would be the most economical for a given amount of work to be performed. If power is cheap, use a machine which, when working at its maximum rate (*i.e.*, external resistance equals internal), will do the required electrical work. If power is expensive, use one much more powerful (*i.e.*, capable of doing more work, if working at its maximum rate), the limit being, when the increased price becomes greater than the saving by increased efficiency, remembering to make the ratio of the external to the total resistance as great as possible.

To illustrate this with an example, let a power of 17,640 volt-ampéres be required, and let a certain machine give an electro-motive force of 840 volts, and have an internal resistance of 10 ohms. If the external circuit is arranged to have a resistance equal to 10 ohms, that is, equal to the internal resistance, the machine will just perform the work, for

$$w = \frac{E^2}{4\,R_{,}} = \frac{(840)^2}{40} = 17{,}640 \text{ volt-ampéres,}$$

and considering the machine perfect, the efficiency will be 50 per cent., and the power used to drive it will be 35,280 volt-ampéres, or its equivalent in horse-power.

Taking two such machines in multiple arc, which is equivalent to one twice as large, with the same electro-motive force, but with one-half the internal resistance, and changing the external resistance to about 29 ohms, the power obtained will be

$$w = C^2 R_{,} = \frac{E^2 R_{,}}{(R_{,} + R_{,,})^2} = \frac{(840)^2\ 29}{(29 + 5)^2} = 17{,}640 \text{ v. a.,}$$

the same as before. The work required will be

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$$W = \frac{E^2}{R_{,} + R_{,,}} = \frac{(840)^2}{29 + 5} = 20{,}748 \text{ volt-ampéres,}$$

and the efficiency

$$\frac{w}{W} = \frac{17{,}640}{20{,}748} = \frac{29 \text{ ohms}}{34 \text{ ohms}} = 85 \text{ per cent.,}$$

very much greater than before. The ratio of the power used to drive them in both cases, will be

$$\frac{20{,}748}{35{,}280} = 59 \text{ per cent.,}$$

showing that only 59 per cent. of the power is required in the second case to do the same work. If the 41 per cent. of power saved is worth more than the interest, etc., on the second machine, it will be more profitable to use two, or one twice as powerful, besides avoiding heating of the armature.

Vienna, October 28th, 1883.

OUR PARIS CORRESPONDENCE.

PARIS, Nov. 1st, 1883.

TELEPHONIC communication between cities that are only a few kilometres distant from each other, has been very rapidly developed in the United States, according to the papers. It was a natural application that was thoroughly comprehended from the first in the country of Graham Bell, but it has not yet received the development in Europe that it is entitled to. Some successful endeavors have been made in England; in Belgium, the Bell Telephone Company has only just obtained the necessary permission to connect a certain number of towns and important localities. There is no talk at all about the matter in France, and with all the administrative formalities, the question is not an easy one to solve. The telephonic system has been very successfully tried in Alsace, and, as usual, the city of Mulhouse owes a debt to the *Société Industrielle*, which took the initiative in procuring for it the advantages of the wonderful invention.

It is scarcely two years since the first telephones were put up in the city, and now the persons who use them acknowledge that they have become as indispensable as the telegraph. The increase in the number of subscribers proves how much these services are appreciated; in the beginning, in January, 1881, there were some seventy subscribers; there are 125 at present, and communication is not restricted to the city, but extends to the neighboring localities: Ile Napoleon, Modenheim, and Sausheim, which are connected with the principal system. During the first year the number of telephonic messages hardly reached 200 a day; they are at present 500, and some days reach the figure of 600.

A telephonic system was established at Guebwiller during 1882, and was extended to the neighboring towns of Issenheim, Bull, Lautenbach, Jungholz and Wuenheim. The number of subscribers was twenty-four, but the system was connected on December 5, 1882 with that of Mulhouse, which increases its importance. There are about twenty messages a day between the two cities, but this is only the beginning. The subscription price both in Mulhouse and Guebwiller is 250 francs per annum. When messages have to pass from one system to another each message is paid by the sender separately, and costs twenty-five centimes, (five cents).

The use of the telephone will be generalized in a short time by the success of this extension. Cernay, Thann and Altkirch in Alsace, and Basle in Switzerland will constitute a system of which Mulhouse will be the centre.

According to the regulations of the German posts and telegraphs, the administration undertakes to put up systems with all the apparatus, &c requisite, but the lines connecting one system with another must be established at the cost of the interested parties, and this was done in the case of the connecting line between Mulhouse and Guebwiller. The length is some twenty kilometres (12½ miles). The cost was 11,000 francs, or some 500 francs per kilometre. The expenses were as follows:

Fifteen to twenty posts	200	francs.
Iron wire of four millimetres	50	"
Insulators, (15 to 20)	25	"
Bearers, screws and fastenings	25	"
Labor	100	"
Overseers of work	40	"
General expenses, fares, &c	60	"
	500	francs.

This first attempt will doubtless decide the German administration to take under its charge connecting lines, without waiting for the interested parties to come to an agreement among themselves as to the payment of the cost. It would be very easy to cover the interest of the capital employed by increasing the subscription rates, and the simplification of the matter would naturally increase the use of the telephone.

Zurich can, in this respect, be cited as a model. There are four subscription rates, 100, 160, 200 and 250 francs, according to the length of the line and the use of the instrument. The average rate is 135 francs. Distant subscribers, outside the regular zone, pay an additional rate of five francs per kilometre. The lowness of the tariffs and their grading are one of the causes of the rapid development of the system, which must soon be greatly extended. It is designed, in fact, to connect all the localities that are in business relations with Zurich, as Winterthur, Thalweil, &c., and to organize connections over a surface of 300 square kilometres, wherein the distance of the furthest point would be thirty kilometres. The credit for the successful results thus obtained must be given to the capable management of the Zurich Telephone Company.

I have already written about the advantages that might be had for telephonic and telegraphic communication by using the silicon bronze wires of M. Lazare Weiller. Although this was a personal opinion, I am at present glad to say that I can support it by an official one, as now a line of 1,000 kilometres is going to be put up with them, and this is a distance that exceeds in general, the direct lines of private companies in France The comparison between the galvanized iron wire hitherto adopted, and the silicon bronze that can do the same work, is sufficiently interesting and novel to allow me entering into some precise details on the subject.

ESTIMATE FOR PUTTING UP 1,000 KILOMETRES OF WIRE.

1st.—Galvanized iron wire of 5 millimetres in diameter.

	francs.
The iron wire will weigh 156 kilos per kilometre, or 156 tons altogether @ 38 francs per 1,000 kilos	59,280
Transported to works, 156 tons @ 20 fr.	3,120
Bearers and insulators 15 per kilometre @ 2 fr.	30,000
Putting up supports, unwinding and putting up and gauging, &c. @ 10 fr. per kilometre	10,000
Two-thirds of the rests must be supported by double posts: 15 rests per kilometre represent 25 single poles @ 12 fr.—25000 x12	300,000
Bringing poles to place @ 1 fr.	25,000
Putting down, single poles 5x1000 @ 2 fr.	10,000
" " double poles, 10x1000 @ 4 fr.	40,000
Bringing 10,000 double poles at 2 fr.	20,000
Total francs	497,400

2d.—Silicon bronze wires of two millimetres in diameter, having electric resistance equal to that of the iron wire of five millimetres, and a resistance against fracture, per square millimetre, superior to that of the iron wire.

The bronze wire weighs 28 kilos per kilometre, and costs 4 francs per kilo, 28x1000	112.000
Freight to works, 28 tons @ 20 fr	560
Supports and insulators, 12 per kilometre @ 1 fr.	12,000
Putting up supports, mounting, unrolling, &c. at 4 fr. per kilometre	4,000
One-third of the rests will be consolidated, either by having 8 single poles and 4 double, per kilometre—16 poles @ 10 fr.	160,000
Cost of bringing 16,000 poles to work @ 1 fr.	16,000
Putting down 8,000 single poles @ 2 fr.	16,000
Putting down 4,000 double poles @ 4 fr.	16,000
Bringing 4,000 double poles @ 2 fr.	8,000
Total francs	344,560

From the above figures, the accuracy of which can be easily tested, it results that while the galvanized iron would come to 497 francs (40 c,) and the silicon bronze to 344 francs (56 c.) per kilometre, the latter would procure a saving of more than thirty per cent., owing more especially that its lightness and resistance to fracture allow of greater spans, and diminish at the same time the number and the price of the poles and supports.

The silicon bronze wire is already used successfully on a certain number of telephonic lines. In Rheims, for instance, and in Italy especially; and it has been given the preference to galvanized iron in the recent experiments of transmission of power at Grenoble. We will not return to the results obtained. Some persons are inclined to impute to ignorance or unworthy motives the criticisms addressed to M. Marcel Deprez.

Under such circumstances, I think it is better not to discuss the matter, I will confine myself to observing that the transmission of power to a distance of fourteen kilometres, is a very remarkable experiment, but that it proves nothing from an industrial point of view. There is some talk of repeating the experiments on a far larger scale. A power of 500 horses would be taken at the starting point, and fifty per cent. of this would be sent a distance of fifty kilometres, and would be distributed among a dozen of real or artificial establishments, at the rate of twenty-five horses on an average for each. It would be quite natural that M. Deprez should accept the challenge, no one is better able to take it up; we shall be heartily glad when the success of it may be proved, but until it be, we shall take the liberty of doubting, and of believing that the problem thus laid down, will not be so soon solved.

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I am not alone, either, in having this opinion, while I can support it, perhaps more than others, from the experiments of capable electricians. Engineers, whose competency and impartiality cannot be questioned, have recently examined various methods for transmitting a power to a distance, so as to utilize a water power of several thousand horses. The object was to store the power produced by the Rhone at its issue from the Lake of Geneva. The conditions were most favorable, as there were a great population, and numerous factories within a radius of three or four kilometres, and which only wanted to make use of the power. M. Legler, an engineer, who is well known for the works he executed in the Valley of the Luith; M. Achard, who has for years taken an interest in the question of transmitting power, and M. Turettini, who is at the head of a large machine shop in Geneva, and well acquainted with the progress of electricity, have drawn up a combined statement, the merit of which we need not go into. Among other points they had to discuss the various methods of transmitting power, and justify any final choice that might be made. The analysis of this part of the work would be out of place here, but we think it will be useful to summarize the observations concerning electricity.

The loss of the product with electricity arises from three principal causes: the heating caused by the resistance of the primary or generative machine, the heating caused by the resistance of the intermediary conductor, and that caused by the resistance of the secondary machine. These three factors, to which there are reasons for adding the friction—relatively feeble however—of the two machines, are the principal causes of the loss of the product, a loss which is not to be made light of; for, in the celebrated experiments of M. Marcel Deprez, at Munich, and in the station of the Northern Railway, in Paris, they reached together about seventy per cent, leaving only some thirty per cent. as an effective.

"It is proper to state," adds M. Turrettini, "that M. Marcel Deprez greatly added to the difficulties of his experiments, as if on purpose, by using iron cables (consequently of enormous resistance), and by trying to produce a difference of potential of several thousand volts in a single machine, which made it exceedingly delicate, and reduced the return obtained by a great proportion, on account of the insufficient insulation of the wires of his machine, when having to do with such enormous differences of tension."

The distance to which the transmission was sent in Paris was 8,500 metres, and it is hardly likely that there are such long transmissions in Geneva; the problem would be, therefore, simplified. But, the question of the electro-motive power remained—from the physiological point of view—that is to say, of accidents to the person. It appears that we may go as far as a tension of 500 volts, and machines are now built in France and Germany that produce that tension; they are built for industrial purposes, and give a return of eighty per cent, either for the generator or the receiving machine. The final return is, therefore, sixty-four per cent., and if ten per cent is added for the cable bringing the electricity from one machine to the other, we arrive at an effective return of fifty-four per cent on the driving shaft of the receiving machine. With a machine producing a tension of 500 volts, and an intensity of fifty ampéres, which is equivalent in electric energy to 2,500 volt-ampéres (2,500 kilogrammetres, or thirty-three horses), it is asserted that we may obtain at a distance of 1,000 metres a power of twenty-three horse on the shaft of the generating machine—a copper cable to be used, having a resistance of 0.50 ohm per kilometre, and costing with its lead casing 2,500 francs per kilometre. (We must point out, however, that the calculations based on the preceding *data* would give only nineteen horses instead of twenty-three). According to M Turettini, the price of two machines and two kilometres of cable, (for both ways), would not exceed 15,000 francs, and counting fifteen per cent for interest and sinking fund, the price per horse per annum would be about 100 francs.

A reference to what I have previously written on this subject, will show that I have never said anything else on the matter. The transmission of power by electricity has not yet left the experimental stage. In Geneva, transmission by hydraulic pressure has been selected, not but that it has its defects, but because it allows us to satisfy, at the same time, domestic requirements and those of industry. This instance shows, too, that consideration which not at all of an industrial character, may in certain cases compel the adoption of some system, no matter how costly the first putting up may be.

I wrote you that the Compagnie Electrique, of Paris, would probably send to the Vienna Exposition a lot of machines for the transmission of great power, invented by M. Gramme. These machines have been working for a month past – they are employed to feed the waterfall in the centre of the rotunda, by means of a Dumont centrifugal pump. The distance between the two machines is 100 metres. The interest of the matter is not in the distance, but in the power developed by the receiver; from twenty five to thirty horse. This is the first time that electric machines of this power have been shown at regular and continuous work. It is a new success scored by M. Gramme. The *savants* at the exposition will not fail to measure the different elements of these new machines, and we will wait the result of their researches before entering more fully into the subject, and citing some indisputable figures.

The Faure accumulators, and M. Phillipart's enterprise are almost forgotten in Paris. The French character does not like to remain long on the same subject, and curiosity in this case soon grew less Will the Société Métropolitaine Electrique (as it is now called) easily find bankers ready to take its issue? Everything depends on this, and the delays at present attending this issue would lead one to suppose that matters are not going on smoothly. In the meantime, M. Phillipart distributes prospectuses, in which he proposes accumulators for illuminating, and giving motive power at home, at the following rates:

Lamp of 6 candles, per hour			8 centimes.
" 12	"	"	14 "
" 20	"	"	20 "

These prices are altogether above the price for gas, and we do not see that there are any grounds for counting upon a large consumption, even in Paris *motive power*

2.5 kilogrammetres, per working hour			15 centimes.
5	"	"	25 "
10	"	"	40 "
20	"	"	60 "
30	"	"	75 "

These rates are also above those of a gas motor, as soon as we arrive at ten kilogrammetres, and the pay of a workman for small power (pedal or crank). At any rate nothing is done for less than thirty working hours per week of effective work, and for less than a year. Even under these conditions, if we consider the working expenses, freight, handling and charging the accumulators, and the general expenses, it will be easily seen that the undertaking cannot be a profitable one.

PH. DELAHAYE.

I have just learned that Messrs de Rothschild have made arrangements with the French syndicate of electricity, which owns M. Marcel Deprez's patents. It is a success on which we may congratulate ourselves from the electric point of view. The credit undoubtedly belongs to Dr. Herz, who has displayed for years his remarkable talent in trying to accomplish the electric transmission of power to a distance.

OUR VIENNA CORRESPONDENCE.

VIENNA, November 1st, 1883.

WHEN the Exhibition first opened there were no new forms of electrical machines, and it seemed as if that branch of the exhibition would have little interest to the electrician; but toward the close, many more were added, among which are some new and very interesting ones, besides improved forms of older ones, so that now the machines are one of the greatest attractions of the exhibition. In regard to the efficiency of the machines, and other data about them, we were unable to obtain any reliable figures, notwithstanding our frequent inquiry; the persons in charge of many of the exhibits either did not wish to give it, or else did not know it themselves—which, we are sorry to say, was frequently the case—or else they gave some figures which a short calculation showed to be incorrect The "scientific committees,' which take the place of the jury here, made very elaborate tests of many of the machines, in which they measured accurately the mechanical energy consumed in the machine while running on open circuit, and then while running at various different speeds on closed circuit, at the same time measuring the electro-motive force, the current strength and all the resistances. When they have completed and published their results it will be, besides the Munich report, the only reliable and accurate collection of data about the various different machines, and will enable the electrical engineer to select from it the best machines for different purposes.

Taking first the constant current machines, by far the greater number use either the Gramme, Hefner-Altenck, or the Brush (Schnckert) armatures, or modifications of them. Of the Gramme type there are the following: Gramme, old and new forms, Ducommun, Egger and Kremenezky, Maxim, Schwerd, Jüngers, Kröttlinger, Bürgin and Crompton, and Gravier (small). The old Gramme needs no further description. The new form consist of from 6 to 12 long cylindrical magnets arranged parallel to each other in the form of a large horizontal cylinder, half of them terminate in one North pole piece, and half in the South pole piece; between these semi-cylindrical pole pieces the Gramme ring revolves. They are used principally for the transmission of power. The Ducommun are Gramme of the old type; they are without doubt the most accurately made and most neatly finished machines here; indeed if one does not look at the belt one would not think the machine was running Those of Egger and Kremenezky have long horizontal oval magnets like in the Weston machines; a good feature is that the brass bearings for the armature are fastened directly to the pole pieces, thus assuring concentricity. The Maxim are the same as those used in the United States The Schwerd have low flat horizontal magnets, like the Weston; their principal feature is that the pole pieces of the magnets are extended around the ends of the ring and to a greater part of the inside, thus having much less dead wire on the armature than the ordinary Gramme ring. The Jüngers (Denmark) has a very odd appearance, having the magnets in the form of two quadrants in a vertical plane, the lower parts terminating in the base, while the upper parts terminate in the pole shoes between

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which the ring revolves; its principal improvement is that it has a fixed electro-magnet inside of the ring, thus diminishing the dead wire very much. The Kröttinger machines have perforated circular discs of sheet iron fastened to the outside of the ring to cause a circulation of the air through the armature. In the Bürgin and Crompton, the ring is separated into 8 or 10 smaller hexagonal parts, thus allowing the air to circulate freely, but increasing the amount of dead wire. The brass bearings are fastened directly to the pole pieces, assuring concentricity and allowing the armature to be removed in a few minutes; from a mechanical point of view, it is the best built machine here. The small Gravier has horizontal magnets, the two extreme ends of which are connected by four stout pieces of iron two of which serve to hold the bearings.

Of those using the Hefner-Altenck armature there are the following: Siemens, Weston, Edison, and Ganz. Those of Siemens and Halske need no further description, except that many of the new ones are "compound," that is, the magnets are wrapped with a fine wire in shunt circuit with the external circuit, and with coarse wire in the main circuit; the object of this construction being to make them self-regulating for a variable external circuit. The principle is explained as follows: if the external circuit is increased, for instance by turning off incandescent lights, less current will go through the coarse wire around the magnets; but as the fine wire is in multiple arc with the external circuit, more current will go through it if the external resistance is increased, thus keeping the magnetism of the machine constant or nearly so, and as the speed remains constant the electro-motive force of the current will remain the same, no matter how much current is used in the external circuit; it is therefore self-regulating between certain limits. Sometimes two of the four magnets are wound with fine wire, and two with coarse, and sometimes each magnet has two windings. The Weston and Edison machines are also well known in the United States, and need no further description. The latter are characterized by their clumsy appearance and want of finish, but at the same time will probably prove to be among the most efficient of those exhibited here. A machine used by Ganz contains 8 magnets radiating around the armature and terminating in four quarter circle pole pieces, thus being a sort of double Siemens' machine; it is used to excite the large alternating current machine.

Those containing the Brush or Schuckert ring armature are the following: Brush (2 forms), Schuckert, Gravier, Spieker and Egger, and Kremenezky. The ordinary form of Brush for tension currents is the same as that used in the United States. The other called the Brush–Schuckert, used for quantity currents, is similar in principle, only that it consists of four magnets on each side, and that the Schuckert ring armature is used. Although there are four sets of poles, the connections of the commutator and the wire on the ring are so made that only two brushes are required. The Schuckert armature is a ring similar to the Brush in principle, only that it is made of thin perforated sheet iron rings, magnetically insulated from each other by discs of zinc, the object of which is to allow the magnetism to change more easily and rapidly. The bundle of rings is wrapped continuously with wire forming a uniform ring; the connections of the wire and the commutator are made as in the ordinary Gramme ring. The magnets and pole pieces in the Schuckert machines are similar to those of the Brush, only that they are round and in a vertical plane. Those used for incandescent are also made "compound" as the Siemens' machines above described. The Schuckert machines constitute a very large portion of all those here, and seem to be very satisfactory. Next to the Gramme and Siemens, it is probably the most frequently used machine in Europe. They are invariably painted a bright green, just as the Brush are always red and the Siemens black. A Schuckert machine was used by the scientific committees for testing the lights, and proved very satisfactory.

The Spieker, and the other Egger and Kremenezky machines are imitation Schuckert machines. In the Gravier the ring is made very thin and broad, being only about one inch thick; the wire is replaced by copper bars to diminish the resistance, and the magnets are made of a large number of small short magnets placed in a circle on both sides of the ring. The principle of the latter seems to be very good, but unfortunately the machine has not been running yet.

Of the other machines the most interesting is the Elfinstone and Vincent, * of which this is the first public exhibition. The armature consists of a large hollow cylinder of *papier mâché*, in the surface of which are fastened many large rectangles of wire, the distance between the long sides of the rectangles being $\frac{1}{8}$ of the circumference. Inside of the armature are 6 radial magnets with alternate North and South poles toward the armature; on the outside of the armature are six more magnets whose poles terminate directly opposite those on the inside, but are of opposite name, so that 6 very intense magnetic fields are produced, through which the wire on the drum passes. From the theory of induced currents it will readily be seen that if a current is produced in one direction in one side of a rectangle, it will be produced in the opposite direction in the other side as the poles alternate; the current will, therefore, be in the same direction around the periphery of the rectangles, or in the whole circuit. It is one of the few machines, if not the only one, in which the field is produced by two *unlike* poles of two electro-magnets, and which has no iron in the armature. The steam engine driving it was indicated a few days ago and showed a consumption of 35 horse-power when the machine was running 400 lights of 16–20 candles, or over 11 lamps per horse-power, the best result, we believe, which has yet been obtained in practice.

* Described in *Engineer*, Jan. 5th, 1883.

Another machine of interest is the Chertemps. It consists of 6 bobbins with horizontal axis, arranged and fixed in a vertical circle; on both sides are six electro-magnets, whose outside ends are fastened to two iron discs which are fixed to the axis. The six magnets on each side are made to revolve; passing by the six coils just as in the Siemens alternating current machine, or the Ferranti, only that in the latter two the coils revolve and the magnets are fixed. The magnet coils are connected with the six commutator strips in such a way, that if the alternating current from the coils is led to the brushes, the current in each magnet remains in the same direction. One coil is thus connected with the magnets and supplies them, while the alternating current from the other five coils is used in the external circuit. It is thus an alternating current machine which excites itself. By connecting all the coils together and passing the whole current through the magnets, and then through two brushes to the lamps, the current is continuous. Thus the same machine may be used for alternating or continuous currents by simply changing the connections. As the coils terminate in separate binding posts, they may be connected for quantity or tension. The attendant remarked that it was the only machine which could be short circuited, which he illustrated by laying a screw driver over the poles of the coils—the lights all went out and the machine ran loose. The explanation is very simple, because when the coils are short circuited no current goes into the magnets, and, therefore, the magnets cannot induce any current in the coils.

Of the alternating current machines there are the following: Siemens, Ferranti, Gramme, Ganz and Klimenkow. The first three are all well known, and need not be described here. The Ganz is a copy of an old form of Siemens, which was discarded by that firm several years ago, and an old form of which is exhibited by that rival firm as an historical relic. It consists of numerous flat coils, arranged parallel to each other along the circumference of a circle, with their axis radiating toward the centre; inside of this circle are as many radiating electro-magnets as there are coils on the outside; the poles at the free ends being alternately North and South. These magnets are made to revolve, and it is easily seen will produce a current in the coils every time a magnet passes a coil. Iron wire is wrapped around the outside of the coils, and acts as the soft iron magnet. There is a large one of this type, the diameter of which is about 10 feet, and is, therefore, termed the "baby." It contains 36 magnets, and is said to supply 2,000 lights in the theatre and its approaches, while consuming only 120 horse-power. The magnets and their frame form the fly wheel of the large engine, which is coupled on the same shaft with it. In the inside of the ring of magnets are two circles of 12 magnets each, radiating toward the centre, with like poles toward each other; between these a Gramme ring revolves, the current from which was intended to supply the electro-magnets, but owing to some unfortunate circumstance, this part does not work, so that another machine has to be used to excite the magnets.

The Klimenkow machine is difficult to describe without a drawing; we will be able to give simply the principle of its construction. There are numerous coils with iron cores arranged parallel to each other in a circle; in the middle is an electro-magnet, whose pole pieces are two iron stars or crosses. This electro-magnet is revolved, the arms of the stars passing by the iron cores of the coils inducing a current every time they pass. These two stars are so set that when one arm of the star of the North pole piece is opposite one end of the coil, the arm of the star of the South pole piece is opposite the other end of the same coil, so as to produce the maximum effect.

* * *

The exhibition will close Sunday evening, November 4. Through the excellent management of its able directors it has been a very great success in every way. Not only has it given the general public an opportunity to see the great progress which electrical engineering has made, and its almost unlimited application, but it has also enabled the electrician to gather a great amount of useful knowledge, and will give him—when the results of the tests of the committee are published—a very valuable set of reliable figures about the most important machines and lamps, from which he will be able to make a fair comparison of their values.

CARL HERING.

—— ONE OF OUR ELECTRICIANS gives us a solution of the rain on Evacuation Day. Mr. Edison informed the court the other day, that electrical wires in rain storms were highly injurious to life. On Evacuation Day the electric lighting and telegraph poles and wires were swarming with boys, who were as thick as sparrows, and yet were not harmed in the least. Providence thus afforded this opportunity of testing the statement of the distinguished professor.

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THE Boston Manufacturers Mutual Fire Insurance Company have issued to their clients, a pamphlet treating of the relative thermic value of various non-conductors for steam pipes, the care of hydrants during freezing weather, and the lubrication of heavy bearings. Under the latter head, reference is made to the utility of attaching thermostats to the journals in a mill, and connecting them in the circuit of an annunciator, so that any undue heating of the journal gives an alarm. In this connection, the pamphlet quotes from the ELECTRICIAN, of last March, an account of a similar device in practical use.

This company insures mills only, and from time to time issue printed instructions based upon their experience, in the matter of fires, acting upon the principle that it is cheapest to prevent a fire rather than to pay for it. This has been exceedingly profitable, and being a mutual company the dividend (at this time 80 per cent) are distributed among the assured in the proportion of the premiums paid. This matter of a return premium, ensures cordial co-operation between the assured and the insurance company.

SPARKS.

—— THE DEATH is announced of Prof. Peter T. Riess. whose treatise on frictional electricity—"Die Lehre von Reibungselektricität" has long been a standard work. His researches on ring-figures produced by discharges on the electric air thermometer, and on the phenomena of the return stroke, are well known. His memoirs on electricity were published in a collected form some years ago.

—— IT IS expected that some forty decorations will shortly be bestowed in connection with the Vienna Electric Exhibition. Among those whose names are mentioned are Sir William Siemens and Sir William Thomson. The latter will, it is believed, receive the Second Class of the Order, of the Iron Crown, which confers on the recipient, under certain conditions, the rank of an Austrian Baron.

—— ONE OF THE NOVELTIES at the Vienna Electric Exhibition is the electrical ballet. The chief features of the entertainment are the introduction of electro-magnets, dynamo machines, telegraph apparatus, and telephones, which were dragged on the stage by fantastic goblins, and handled by the graceful danseuses with as much ease as if they were especially trained in the mysteries of electricity. One of the prettiest scenes is the telegraph-polka, which is danced by two ladies in the costume of telegraph boys.

—— MR. E. VAN DER VEN has been making some researches on the use of phosphor bronze and silicon bronze wires for lines, the practical results of which are that their resistances compared with copper of the same diameter are: Phosphor bronze, 30 per cent.; silicon bronze, 70 per cent.; steel being 10 5 per cent. The stretch that can be given from pole to pole is, for steel, 2mm. diameter, 130 ft.; phosphor bronze or silicon bronze. 1 mm. diameter, 106 ft. and 91 ft. respectively. It is assumed that a bronze wire, on account of its elasticity, would coil up before it had fallen far if broken, thus preventing accidents from broken wires.—*Engineering.*

BUSINESS NOTICES.

TO THE PUBLIC.

Office of
THE ELECTRIC GAS LIGHTING CO.,
45 Milk Street,
BOSTON, Mass, Oct. 25, 1883.

NOTICE is hereby given that the contract heretofore existing between this company and The Electrical Supply Company of Ansonia, Conn., whereby the latter was licensed to manufacture and sell ELECTRIC GAS LIGHTING APPARATUS, under the patents owned by the former, was canceled by this company on the 20th day of September, 1883, for non-fulfillment and violation of its terms, conditions and covenants, on the part of said Electrical Supply Company.

Any manufacture or sale of said apparatus by said Electrical Supply Company, since the cancellation of said contract, is an infringement of the patents, and in violation of the rights of this company, and all parties who shall sell, purchase or use said apparatus, thus manufactured, will be held responsible. We have perfected arrangements for the prompt construction of the apparatus by manufacturing electricians who have had extended practical experience in this line of work, thus insuring the production of properly made and perfect working burners, which we shall supply to our agents and patrons in full confidence that they will give entire satisfaction.

We regret the interruption and delay which has been occasioned by the action of The Electrical Supply Company, but its failure to furnish the apparatus according to contract, and the small amount which it did furnish while said contract was in force, was so defective in construction and inferior in quality, that it became our imperative duty to ourselves and our patrons, to exercise our right to terminate the contract for breach of its conditions.

THE ELECTRIC GAS LIGHTING CO.,
by Louis W. Burnham, President & Business Manager.

BINDERS FOR THE ELECTRICIAN.

COMMON-SENSE Binders, of suitable size for one volume, price one dollar each, postage paid.

WILLIAMS & CO.,
115 Nassau Street, New York.

WANTED—A set of Vol. 1 ELECTRICIAN in clean condition. State lowest price. Address Sam'l S. Green, Free Public Library, Worcester, Mass.

A Competent Engineer now employed by an electric light company, in the South, running a high speed engine, wishes to make a change. Address, A. B. C., office of this paper.

WANTED.—A situation as Superintendent with an electric lighting company. The advertiser has had experience in lighting from central station and by isolated plants (arc and incandescent). Address, S. A. E., this office.

THE ELECTRICAL CABINET, an appropriate holiday present for young people. It is little more than a foot square, and contains an electrical plate machine of wonderful capacity, electrical balls, orrery, pith-balls, electrometer, cannon, head of Medusa, Leyden jar, discharger, spiral tube, vacuum tube, box of amalgam, chain, and an elementary guide in electricity. It is eminently adapted to giving instructive and amusing entertainment to young and old alike. See adv't., C. W. Meyer, 11 Dey St., N. Y.

E. & F. N. SPON have just issued a biographical sketch of Philipp Reis, inventor of the telephone; with documentary testimony, translations of the original papers of the inventor and contemporary publications. The volume is compiled by Sylvanus P. Thompson, Professor of Experimental Physics in University College, Bristol, who says in concluding the sketch "If mere mechanical imperfections do not make an invention any the less a true invention, it would be dishonest to deny to Philipp Reis the honor of the invention, of which he openly stated the successes and the imperfections." The volume is illustrated by explanatory engravings showing the original Reis telephones with all their details of construction. Copies of above, price $3.00, as well as any of the latest books on electricity, can be obtained at 35 Murray Street, New York, or will be sent free by mail on receipt of price.

THE ELECTRIC GAS LIGHTING CO. of Boston, have entered into contracts with competent and responsible manufacturers, to get up their burners as quickly as possible. These contracts cover the ownership of the dies and tools, thus leaving the way open for them to undertake the manufacture of their own goods at any time it may appear for their interest to do so.

These new arrangements have been made with the determination to produce the finest and most practical line of *electric gas lighting devices extant*, which are being made under the direct supervision of first-class manufacturing electricians who have had years of practical experience in this line of work, thus insuring the production of properly made and perfect working burners

They expect to begin to furnish licenses, with at least one style of automatic, and four styles of pendant burners, on or before the 15th day of December; and a full supply of all the varieties will be ready for the trade at an early day. Address

LOUIS W. BURNHAM, Prest.,
45 Milk St., Boston, Mass.

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THE PHOSPHOR-BRONZE SMELTING CO., Limited, of Philadelphia, are now prepared to furnish phosphor-bronze insulated wires for telephone, district telegraph, telegraph, and similar service, which possess very valuable advantages over the covered iron wires now in use for such purposes.

The high tensile strength of phosphor-bronze wires renders them capable of supporting the extra weight of the coating without undue strain or stretching; their low resistance, which is only about one-half that of iron wires of same weight per mile, makes it possible to use wires only one-half as large for lines of the same length, without sacrificing any of the necessary conductivity, and being practically non-corrosive, the insulated coating is not damaged by rust, which rapidly destroys the covering of iron wires exposed to the weather.

For line wires running through trees, and liable to contact with other wires or means of escape for the current, these wires will commend themselves to practical electrical engineers, and their low cost, conductivity considered, will place them within their reach for many purposes, where other wires have heretofore been used.

H. C. LÜDERS.

ST. LOUIS, Oct. 22, 1883.

The Shultz Belting Co., James Garnett, Manager, 140 N. Third street, Philadelphia.

GENTLEMEN.—We desire to express to you our opinion of your belts, made for us and now in use at our lighting station in this city.

We have in our varied experience used all, or nearly all, kinds of belts, and have never found one that would give us the satisfaction which your belt has done.

We need in our business a perfect transmission of power, no slipping of belts, either caused by rivets or looseness can be allowed; with your belts we have had nothing of the kind.

To illustrate, some four months ago we purchased a belt and had it made endless, and placed it on a machine connecting straight with engine, that belt has been running ever since, in use every day, and all the tightening we have done is to pull the machine back from the engine one inch.

Our experience with your other belts is just the same. We should be most happy for you to refer any one to us for reference, as to the excellence of your belts for running electric lighting apparatus.

Respectfully,

BRUSH ELECTRIC ASSOCIATION,
by W L. B G Allen,
Secretary.

REVIEWS.

PRACTICAL ELECTRICAL UNITS POPULARLY EXPLAINED; by James Swinburne. 61 pp. 16mo. London and New York: E. & F. N. Spon

When electric lighting began to be an industry, some of the leading companies were obliged to embody in their instructions much electrical information of a general nature, because there was no published book containing the desired elements of instruction which were essential to many of their subordinates. This little book is adapted to just such a field. The author essays the difficult task of giving definitions, and succeeds in such a perfect manner, that one is inclined to wish that the book had been projected on a somewhat wider scope.

In the next edition we trust to see tables of equivalents of mechanical and electrical energy, similar to the one in our issue of last April.

ELECTRICITY AS A MOTIVE POWER; by Count Th. Du Moncel, and Frank Geraldy. Translated and edited with additions by C. J. Wharton. 316 pp. 8vo. E. & F. N. Spon, London and New York

This last volume, from the pen of this eminent electrician, is a work which will prove of value to the numerous persons engaged upon the problem of the transmission of electricity and its conversion into work. Those who have not given attention to the question of electro-motors, have little conception of the difficulties which beset the problem of converting electricity into work. In the one item of precedents furnished by the description of all the known types of motors, this book will prove of utility to those who are dealing with the subject of electro-motors.

Passing by the introduction, which glorifies the subject in a manner well suited to catch the ear of a "popular science" reader, the question of electro-magnets is treated in a very able manner. The illustrations showing various forms of electro-magnets, furnish suggestions of means to overcome the difficulties frequently arising in designing electrical apparatus The laws governing the construction and operation of electro-magnets, as given at length in a small book on the subject by the same author, about a year ago, are here stated in a few clear and condensed pages.

One difficulty in the earlier electro-motors, and which is common to all apparatus using electro-magnets, is the rapidity with which the strength of the magnetic field decreases as the armature is withdrawn from the magnet.

Several devices are illustrated which are made for the purpose of converting the varying magnetic force into uniform work One of them, Fig. 27, by Houdin and Froment, shows a pair of levers in juxtaposition by a rolling contact. The armature pulls the end of one lever and as its position changes, the leverage varies inversly in the proportion of the square of the distance which the armature moves. The curved sides of these levers are either ellipses with the fulcra of the levers at the foci, or one of the spirals, although the author makes no reference to the matter. As an illustration of how similar devices may be independently re-invented, many years ago, we saw in one of the Mechanics' Fairs, in Boston, a pair of scales invented by a man named Shaw, wherein weights placed on the scales were indicated on a dial as in a spring scale, only the weight was transmitted to the dial through a pair of curved levers like those cited in this book. The exhibitor had produced the curves (ellipses) by actual trial, and innocently related the difficulties experienced in trying to find a patent solicitor who could describe the "kind of a circle" used on his invention. The expense of the scales probably restrained their introduction.

Froment's method of distributing the magnetic force is by means of a toggle joint, and, therefore, crudely approximate.

Methods of lengthening the attractive force of a magnet by shaping the poles in cores (Pellis and Henrys), and wedges (Froment) are shown; but it is a matter of surprise that the author did not cite the method successfully used by Professors Thomson and Houston in this country, to render the attractive force of a magnet either uniform or variable in any desired ratio by terminating the poles in paraboloids (approximately), and allowing them to extend through holes in the armatures.

We do not see anything upon the subject relative to the ratio between the length of a magnet, and the position of a centre of magnetic intensity.

The subject of the historical motors begins with that of Jacobi, 1834–1838, and subsequent to 1844, the early motors are classed under four heads: First, those depending upon solenoids; second, electro-magnets; third, those in which gravity is used; fourth, electro chemical motors. Then the question of the reversible motors, or those on the principle of the revolving armature, which began in the revolving bobbins of Pixii, and developed by later inventors into the various types of armatures used in all dynamo machines.

Many instances are given of the uses of electro-motors for propelling boats, locomotives, carrying packages, tricyles, playing piano (hope it won't work) lifting water, sewing machines and passenger elevators.

Upon the important problem of the regulation of electro-motors, the author unfortunately gives no light, save a clear statement of the principles involved, but for the good reason that no inventor has as yet produced an electro-motor which can be governed under varying conditions of load, with an economy and efficiency comparable to the limits of regulation demanded of steam engines and water wheels.

The translator has performed his part in an admirable manner, rendering the French text of the author into pure English, free from foreign idiom.

We commend the book to our readers as being the latest exposition of the state of the art of electro-motors, and full of information for all interested in electricity.

WORKSHOP RECEIPTS; (second series), by Robert Haldane. 485 pp. 12mo. London and New York: E. & F. N. Spon.

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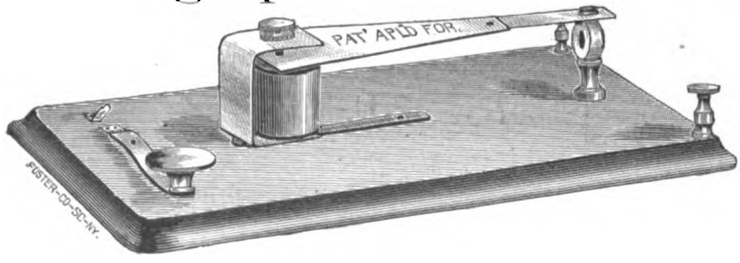

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287,722 Burglar Alarm, Detonating. W. H. Reiff, Philadelphia, Pa.
287,618 Electric Alarms, Circuit Closer for. L. A. Brigel, Cincinnati, Ohio.
287,641 Electric Battery. A. F. Delafield, New York, N. Y.
287,538 Electric Circuits, Safety Catch for. C. Goddard, New York, N. Y.
287,516 Electric Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,608 Electric Generator, Dynamo or Magnetic. F. Bain, Chicago, Ill.
287,654 Electric Lighting Systems, Indicator for. W. P. Freeman, Brooklyn, N. Y.
287,609 Electric Machine, Dynamo. F. Bain, Chicago, Ill.
287,610 Electric Machine, Dynamo. F. Bain, Chicago, Ill.
287,512 Electric Machine, Dynamo. T. A. Edison, Menlo Park, N. J.
287,513 Electric Machine, Dynamo. T. A. Edison, Menlo Park, N. J.
287,514 Electric Machine, Dynamo. T. A. Edison, Menlo Park, N. J.
287,611 Electric Machine, Dynamo or Magneto. F. Bain, Chicago Ill.
287,521 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J.
287,523 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J.
287,661 Electric Machine, Dynamo or Magneto. J. E. Giles, Hazleton, Pa.
287,774 Electric Machine, Dynamo or Magneto. P. P. Nungesser, Cleveland, Ohio.
287,524 Electric Machine, Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
287,565 Electric Machine Regulator, Dynamo. G. I. Murdock, Binghamton, N. Y.
287,678 Electric Machine, Wiper for the Commutators of Dynamo. Alpena, Mich.
287,511 Electric Regulator. T. A. Edison, Menlo Park. N. J.
287,532 Electric Conductors, Junction for. C. Goddard, New York, N. Y.
287,525 Electrical Distribution, Regulator for Systems of. T. A. Edison and C. L. Clarke, Menlo Park, N. J.
287,515 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,517 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,501 Electrical Testing. C. J Bradley, New York, N. Y.
287,664 Fire Alarm Apparatus, Electric. W. C. Gordon, England.
287,758 Flat Iron, Electric, R. N. Dyer, and. N. W. Seely, Menlo Park. N. J.
287,766 Insulated Electric Conductor. G. W. McGill, New York, N. Y.
287,776 Insulated Electric Conductor. H. O. Phillips, Waterbury, Conn.
287,519 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
287,520 Lamps, Incandescing Conductor for Electric. T. A. Edison, Menlo Park, N. J.
287,518 Lamps, Manufacturing Incandescing Electric. T. A. Edison, Menlo Park, N. J.
287,773 Magneto Electric Machine. P. P. Nungesser, Cleveland, Ohio.
287,446 Railway Signal, Electric. W. W. Le Grande, Louisville, Ky.
287,466 Railway Signals, Electrical Connection for. T. J. Pottenger, Louisville, Ky.
287,742 Telephone Receiver. H. E. White, New York, N. Y.
287,743 Telephone Receiver. H. E. Waite, and S. H. Bartlett, New York, N. Y.
287,710 Telephone Time Signal Repeating System. J. M. Oram, Dallas, Texa .
287,490 Telephone Transmitter. E. L. Wilson, Boston, Mass.
287,449 Telephonic Repeater and Relay. J. A. Maloney, Washington, D. C.
287,401 Time Detector, Electric. T. Ahearn, Ottawa, Ontario.
287,775 Time Lock, Electric. W. E. Peirce, Newark, N. J.

NOVEMBER 6th.

287,850 Burglar Alarm, Detonating. W. Noblett, Chicago, Ill.
288,175 Clock Systems, Circuit and Apparatus for Electric. Jas. Hamblett, Brooklyn, N. Y.
287,841 Dynamometer. J. McCloskey, Boston, Mass.
287,800 Dynamometer, Electro-magnetic. C. F. Bracket, Princeton, N. J.
10,401 Electric Cables, Machine for Making. J. Farrell, (Re-issue).
10,402 Electric Cables, Machine for Making. J. Farrell, (Re-issue).
288,089 Electric Circuits, Station Call for. T. W. Mather, New Haven, Conn.
287,881 Electric Lights, etc., Tower for. C. D. F. Smith, Aurora, Ill.
288,042 Electric Machine, Dynamo. W. B. F. Elphenstone, and C. W. Vincent, England.
288,051 Electric Machine, Armature for Dynamo. J. E. Giles, Hazleton, Pa.
287,812 Galvanic Battery Cell. L. E. Felton, Pottsdam, N. Y.
287,855 Gas Engines Electric igniting Device for. L. C. Parker, Yonkers, N. Y.
288,002 Insulating, Carrying and Laying Electric Wires. F. W. Brown, Rochester, N. Y.
10,403 Insulating Compound for Electrical Conductors, and Apparatus for Compounding the same. J. B. Hyde, (Re-issue).
10,404 Insulating Material to Electric Wires, Apparatus for applying. J. B. Hyde, (Re-issue.)
287,880 Insulator Telegraph. C. C. Hinsdale, Cleveland, Ohio
287,875 Lightning Arrester. C. J. Shepard, Raymond, N. H.
287,929 Lightning-rod Coupling. W. Hewitt, London, Ontario.
287,957 Paper, &c., Electrical Apparatus for Controlling. J. W. Osborne, Washington, D. C.
288,107 Telegraph, District, Police, or Fire. F. Pearce, New York, N. Y.
287,914 Telegraphic Transmitter. M. H. Dement, Chicago, Ill.
287,873 Telephone Call Boxes, Automatic Crank Switch for. C. E. Scribner, Chicago, Ill.
287,896 Telephone Receiver. S. H. Bartlett, and H. E. Waite, New York, N. Y.
288,183 Telephone Support. C. H. Ohly, Sandusky, Ohio.
288,017 Telephonic Transmitter. H. Clay, Philadelphia, Pa.
288,157 Voltaic-arc Light. W. Baxter, Jr., Jersey City, N. J.

NOVEMBER 13th.

288,570 Annunciator and Fire Alarm, Electric Hotel. A. T. Hess, Des Moines, Iowa.
288,202 Bell, Polarized Electric. W. J. Bowen, Norwalk, Ohio.
288,496 Clock, Electric. L. P. Schlaefli, Soleure Switzerland.
288,315 Electric Currents, Apparatus for Regulating. S. Z. De Ferranti, and A. Thompson, England.
288,393 Electric Light Circuits, Current Regulator for. C. R. Arnold, Philadelphia, Pa.
288,316 Electric Machine, Dynamo. S. Z. De Ferranti and A. Thompson, England.
288,318 Electric Machine Regulator. Dynamo or Magnetic. T. A. Edison, Menlo Park, N. J.
288,536 Electric Signal Box. J. C. Wilson, and M. G. Davis, Boston, Mass.
288,555 Electric Wire Conduit. B. A. Dryer, New York, N. Y.
288,311 Electric Wires, Subterranean Line of. H. B. Cobb, Wilmington, Del.
288,310 Electric Wires, System of Laying Subterranean Lines of. H. B. Cobb, Wilmington, Del.
288,443 Electrical Conductor, Compound. L. Johnson, Vincennes, Ind.
288,556 Electrical Signal. E. Dummer, Boston, Mass.
288,454 Insulating Electrical Conductors. Machine for. J. Kruesi, Brooklyn, N.Y.
288,360 Insulator, Telegraph S. Oakman, Melrose, Mass.
288,346 Lamp, Electric. E. R. Knowles, Brooklyn, N. Y.
288,217 Lamps, Contact for Electric. H. Edmunds, Jr., New York, N. Y.
288,218 Lamps, Contact for Electric. H. Edmunds, Jr., New York, N. Y.
288,513 Railway and Locomotive, Electric. W. M. Thomas, Cincinnati, Ohio.
288,215 Telephone. A. E. Dolbear, College Hill, Mass.
288,320 Telephone Holder and Automatic Circuit Breaker, Adjustable. W. N. Eckert, J. A. Seely, and E. A. Eckert, New York, N. Y.
288,449 Telephonic Apparatus. J. H. Kinsman, Rye, N. Y.
288,366 Telephonic Communication, Apparatus for. J. H. Rogers, Washington, D. C.

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288,623 Clocks, Actuating Device for Secondary Electric. A. S. Crane, Newark, N. J.
288,790 Electric Conductors, Underground Conduit for. J. E. Giles, Hazleton, Pa.
288,888 Electric Lighting on Railway Trains, Apparatus for. W. Stroudley, and E. J. Houghton, England.
288,818 Electric Machine, Dynamo. A. J. Kimball, Worcester, Mass.
288,829 Electric Machine, Dynamo. T. J. McTighe, Pittsburg, Pa.
288,963 Electric Machine Regulator, Dynamo. J. S. Beeman, W. Taylor, and F. King, England.
288,830 Electric Machines, Commutator for Dynamo. T. J. McTighe, and J. T. McConnell, Pittsburg, Pa.
288,629 Electrical Wires Underground, Housing and Insulation of. C. C. Gilman, Eldorado, Iowa.
288,916 Galvanic Battery. S. Bergman, New York, N. Y.
288,826 Lamp, Electric-arc. J. T. McConnell, Pittsburg, Pa.
288,831 Lamp, Electric arc. T. J. McTighe, and J. T. McConnell, Pittsburg, Pa.
288,682 Lamps, Safety Cut-out for Electric. C. J. Van Depoele, Chicago, Ill.
288,915 Magneto-Electric Machine. J. S. Beeman, England.
288,795 Telegraph Cables, Apparatus for Making. A. H. Hamon, Paris, France.
288,786 Telegraph, Dynamo Multiple. J. D. Field, New York, N. Y.
288,609 Telegraph Key. H. Anderson, Peekskill, N. Y.
288,881 Telegraph Sounder. W. C. Smith, Philadelphia, Pa.
288,908 Telephone Cut-out. C. T. Wright, and C. A. Fisher, Petersburg, Ill.
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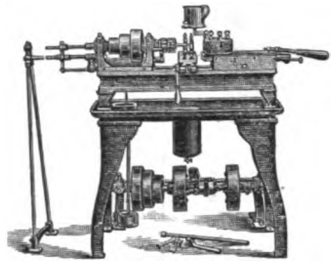

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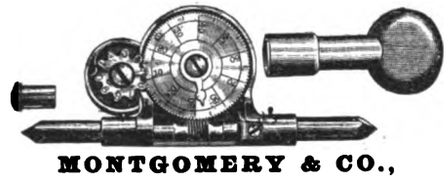

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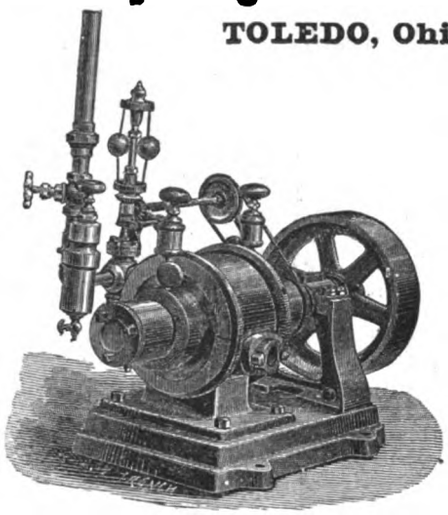

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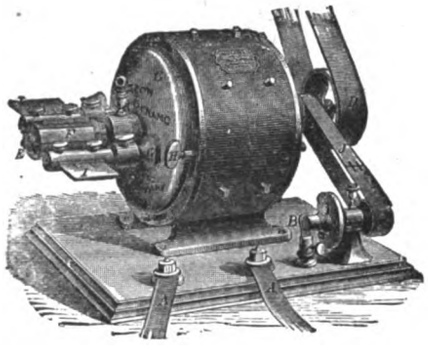

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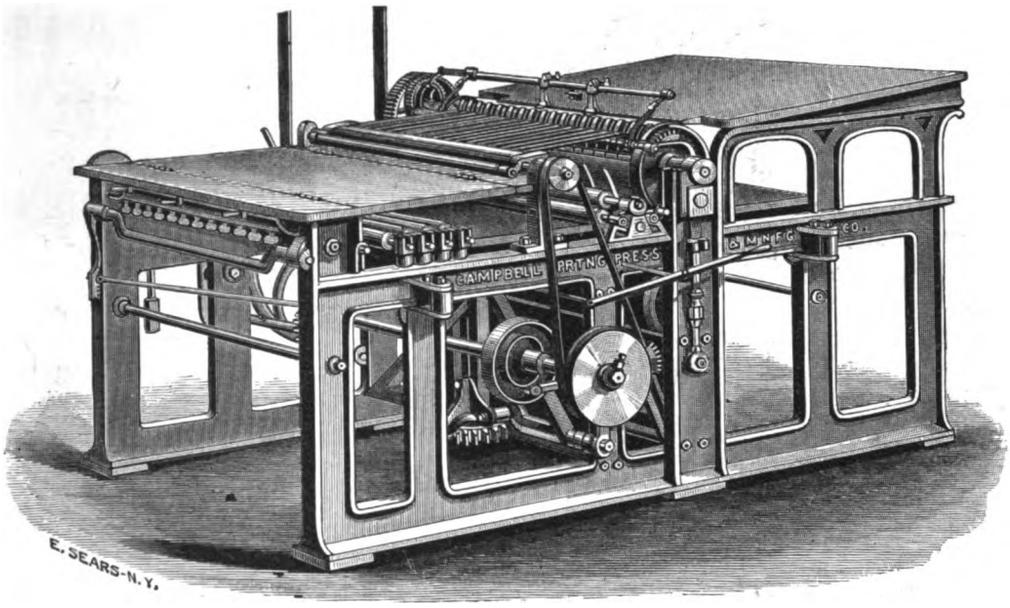

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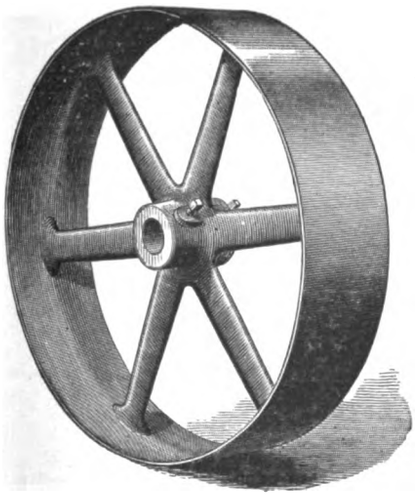

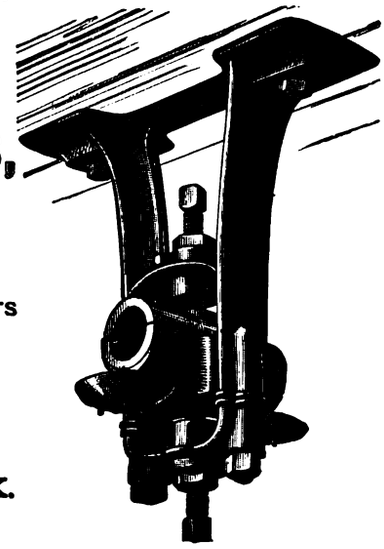

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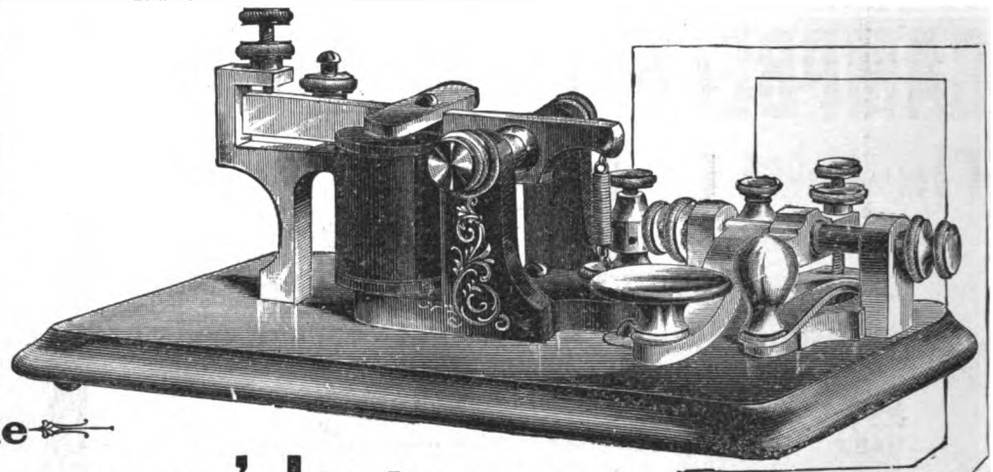

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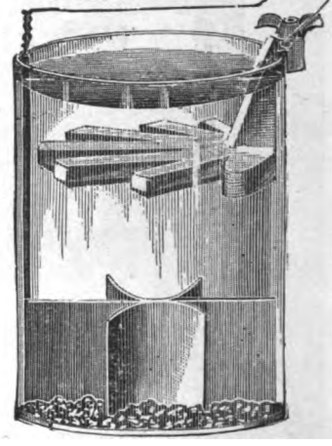

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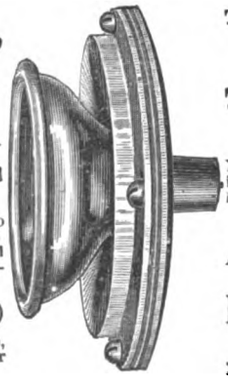

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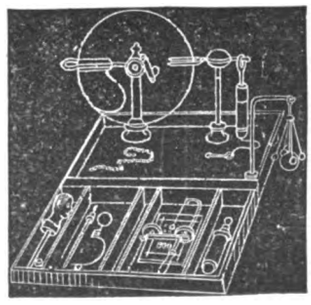

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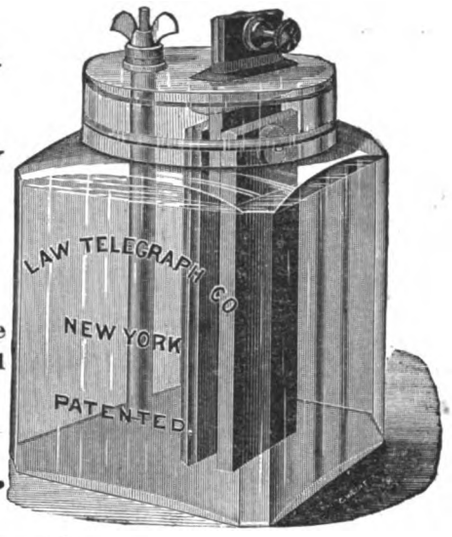

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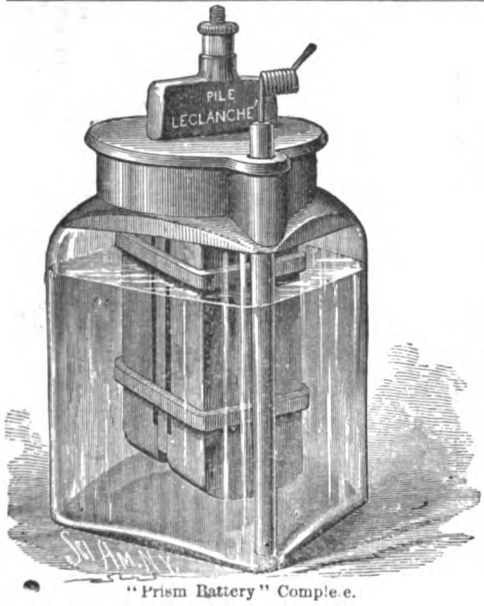

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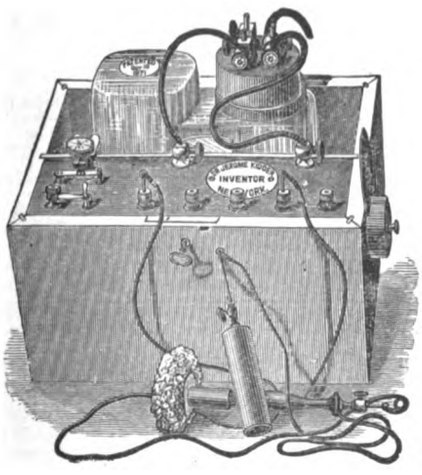

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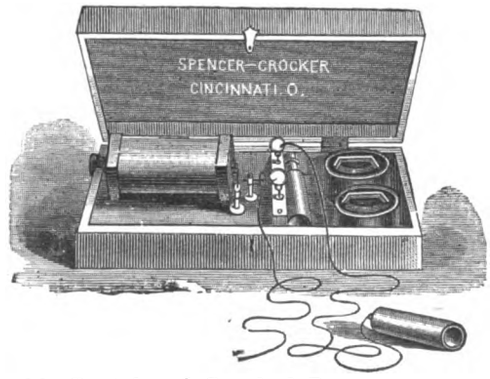

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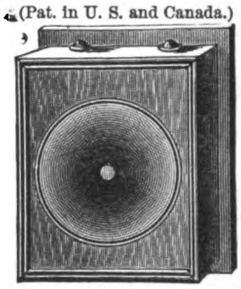

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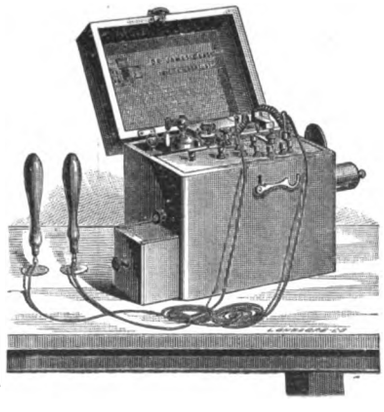

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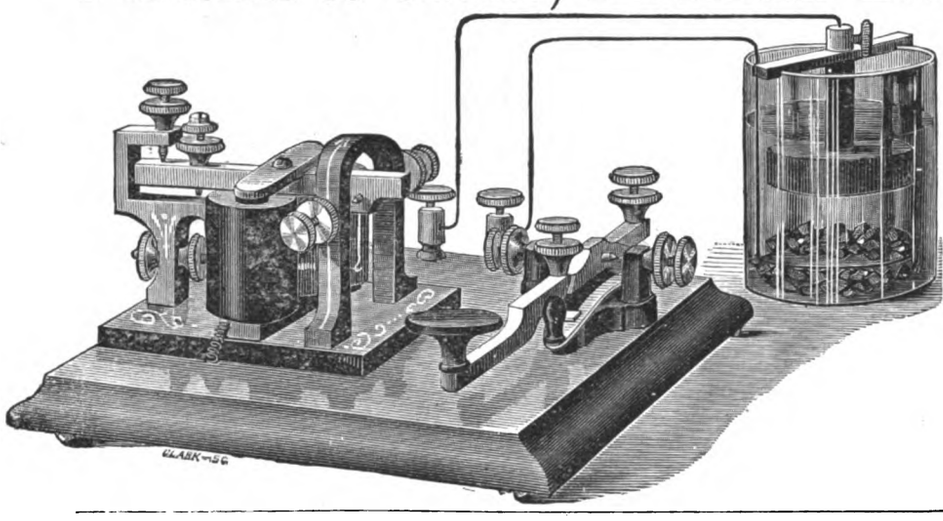

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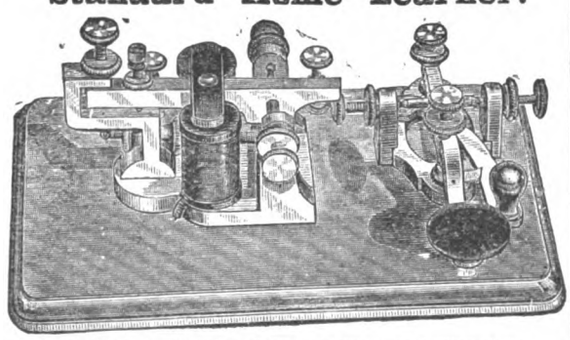

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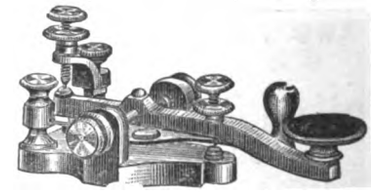

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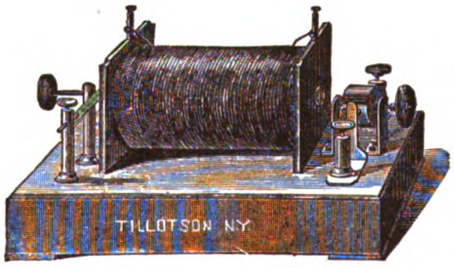

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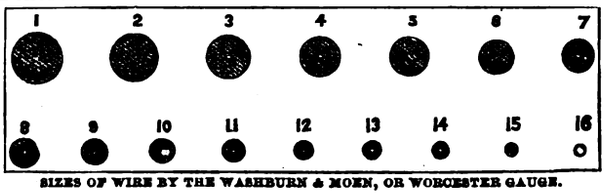

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